THE

# ELECTRICAL REVIEW.

VOL. XLVIII. JUNE 7, 1901. No. 1,228.

## CONTENTS:


| | PAGE |
|---|---|
| Provisional Orders and the Local Government Board ... | 957 |
| Localisation of High Resistance Breaks (*illustrated*) ... ... | 959 |
| On Anode Rays (*illustrated*) ... ... ... ... ... | 962 |
| The Electrical Volunteers ... ... ... ... ... | 963 |
| On Polyphase Generating and Sub-station Plant for Electric Traction ... ... ... ... ... ... ... ... | 963 |
| Municipal Enterprise ... ... ... ... ... ... | 965 |
| Experiments in Wireless Telegraphy with the Guarini Automatic Repeater (*illustrated*) (*continued*) ... ... ... | 966 |
| Edison's New Storage Battery ... ... ... ... ... | 968 |
| Correspondence:— | |
| Storage Battery Traction ... ... ... ... ... | 970 |
| The Dudley and Stourbridge Tramway Power House ... | 970 |
| Local ... ... ... ... ... ... ... ... | 971 |
| Business Notes ... ... ... ... ... ... ... | 971 |
| Electric Lighting and Traction at Ilford (*illustrated*) ... ... | 977 |
| How to Push Foreign Business ... ... ... ... ... | 979 |
| Supply Station Accounts ... ... ... ... ... ... | 986 |
| City Notes ... ... ... ... ... ... ... ... | 986 |
| Traffic Receipts ... ... ... ... ... ... ... | 988 |
| Stocks and Shares ... ... ... ... ... ... ... | 988 |
| Share List of Electrical Companies ... ... ... ... | 989 |
| Market Quotations ... ... ... ... ... ... ... | 990 |
| Metal Market.—Fluctuations in May ... ... ... ... | 991 |
| Institution of Electrical Engineers:— | |
| A Watt-Hour Meter (*illustrated*) (*concluded*) ... ... | 991 |
| The Continental Electrical Engineering Industry (*concluded*) | 993 |
| Electrical Progress in Australasia ... ... ... ... ... | 993 |
| Niagara Power Developments ... ... ... ... ... | 994 |
| Our Legal Query Column ... ... ... ... ... ... | 994 |
| Notes on the Theory of Synchronous Motors and of Alternators in Parallel (*illustrated*) (*continued*) ... ... ... | 995 |
| Current Specifications.—LXIV. and LXV. ... ... ... | 997 |
| Desirability of Tramway Securities as Investments ... ... | 997 |
| The Castner-Kellner Case ... ... ... ... ... ... | 998 |
| New Patents ... ... ... ... ... ... ... ... | 999 |
| Abstracts of Published Specifications ... ... ... ... | 999 |


THE

UNIVERSAL ELECTRICAL DIRECTORY

**1901 Edition**

**NOW READY.**

**H. ALABASTER, GATEHOUSE & CO.,**

***4, Ludgate Hill, London, E.C.***

THE ELECTRICAL REVIEW.

**Published every FRIDAY, Price 4d.**

*The Oldest Weekly Electrical Paper. Established* 1872.

TO BE OBTAINED BY ORDER FROM ANY NEWSAGENT IN TOWN OR COUNTRY.

***OFFICE:—4, LUDGATE HILL, LONDON, E.C.***

Telegraphic Address: "AGEEKAY, LONDON." Code, A B C.

Telephone No. 933 Holborn.

***ALL Letters should be addressed to the Proprietors, H. Alabaster, Gatehouse & Co.***

ADVERTISEMENT RATES ON APPLICATION.

**The "Electrical Review" is the recognised medium of the Electrical Trades,**

AND HAS

***BY FAR THE LARGEST CIRCULATION***

**of any Electrical Industrial Paper in Great Britain.**

*SUBSCRIPTION RATES.*—In Great Britain, Post Free per Year, 19s. 6d. To all other countries, per Year, £1 10s.

*BINDING.*—Subscribers' numbers bound, including case, for 4s. each volume.

*CASES.*—Cloth Cases for Binding can be had, price 2s. 6d. each.

*READING CASES*, to hold from One to Twenty-six Numbers until the volume is complete for Binding, can now be had from the Publishers, Price 6s., or Free by Post (in Great Britain), 6s. 6d.

*FOREIGN AGENTS.*—New York: D. VAN NOSTRAND, 23, Murray Street. Paris: VEUVE J. BOYVEAU, 22, Rue de la Banque. Berlin: ASHER & Co., 13 Unter den Linden.

Cheques and Postal Orders (on Chief Office, London), to be made payable to Mr. H. ALABASTER, 4, Ludgate Hill, E.C.

## PROVISIONAL ORDERS AND THE LOCAL GOVERNMENT BOARD.

THE Local Government Board have nothing to do with the granting of provisional orders for supply of electricity—but their interference becomes necessary, when municipalities are the undertakers, and borrowing powers are sought for providing the necessary capital. The provisional order is granted under the Electric Lighting Acts by the Board of Trade, who are bound to give a preference to applications by local authorities, and only in rare instances dispense with their consent in the case of private companies.

Provisional orders are very frequently taken by local authorities without any intention of working them—but with the object of either preventing the new industry from obtaining a footing in the town—or for the purpose of securing the best terms from competing companies prepared to assume the responsibilities of undertakers.

The Board of Trade have taken every means of preventing the traffic in these provisional orders, and in 1899 adopted the stringent remedy of discontinuing to allow the transfer clause under which such transactions previously took place.

That there was good ground for the new regulation may be instanced by the action of the Corporation of Southend-on-Sea, which proved that local authorities held the opinion that they could deal with their provisional order as a marketable asset. On March 6th, 1899, the town clerk issued "particulars for the information of tenderers for a temporary transfer by the Corporation of their powers under the Southend Electric Lighting Order, 1891," and the first requirement mentioned was "the amount to be paid to the Corporation by way of recouping them for the expenses incurred in obtaining the order and subsequent expenses, and also by way of premium for the concession. This may be in one payment, or by way of alternative, an annual payment may be suggested."

Among the tenders received was one containing an offer of £2,500 premium for the concession, but this fact coming to the knowledge of the Board of Trade, the terms of the particulars were altered by the omission of the words "also by way of premium for the concession," and fresh tenders were invited. It is significant that in the same year the new policy of omitting the transfer clause was adopted.

That the impression prevailed that these provisional orders were marketable, was proved in a recent Local Government Board inquiry for permission to obtain a loan. One of the Councillors gave evidence against the scheme of the local authority, and was asked in cross-examination whether he had not voted for the application for a provisional order by the Council, and how under such circumstances he could oppose the carrying out of the undertaking. His reply was that it was understood that if the order were obtained

*it would be a valuable asset which could be sold to a company*, and that was his only reason for supporting it.

The position of the Local Government Board under this state of affairs is a most important and responsible one, and deplorable mischief may follow unless they fully recognise that it is their duty to take into consideration all the facts of the case before assenting to a loan and committing the ratepayers to a speculation against which they may be opposed with practical unanimity.

In the recent inquiry to which we refer, the Council being divided in opinion, two of the dissentient members decided upon taking a poll of the ratepayers. Voting papers signed by these two members of Council were left at every house and subsequently collected, with the result that a majority equal to three-fourths of the entire body of ratepayers voted against the scheme of the Council being further carried out. Further evidence was given in the election of Councillors a few weeks before the inquiry, the candidates who made opposition to the scheme of the Council as the ground of their appeal to the ratepayers being all elected, displacing those who favoured it.

The Local Government Board may argue that, inasmuch as the Board of Trade have granted the provisional order and press for the fulfilment of its obligations, they have no right to refuse the means of carrying it out; moreover, that as the ratepayers did not oppose the application for the provisional order they have no right afterwards to oppose its being carried out.

This may be logical reasoning, but the well-known facts alter the position, and require the Local Government Board to protect the ratepayers by allowing them to give the ultimate decision as to whether they wish to embark in the speculation or not.

If this view of the duties of the Local Government Board were correct there would be no necessity for any public "inquiry into the subject-matter of such application," as the proofs as to the financial position of the town could be ascertained under certificate from the local authority, the scheme of supply being dealt with by the Board of Trade, and the probable commercial results of the trading being more or less a matter of speculation and guesswork might be dispensed with.

But, as a matter of fact, the object of the "inquiry" is clearly set forth in the notices signed by the secretary to the Local Government Board, which state that "the inspector appointed to hold the said inquiry will attend for that purpose at ——— on ———, 1901, and will then and there be prepared to receive the evidence of any persons interested in matter of the said inquiry."

Another strong reason why the Local Government Board should consider all the circumstances of the case before committing the ratepayers to carry out any scheme, is the fact of the whole question of electricity supply being more or less in a transition state.

The creation of great power stations for the supply of enormous areas under a system of long-distance transmission of the current is actually in its infancy—the first Acts of Parliament dating only from last year—consequently the idea of isolated generating stations for supply of a single town may be, in a measure, superseded by the more comprehensive method, and many of the works put down under the old-fashioned system may become obsolete.

This development alone should influence the Local Government Board in giving the ratepayers an opportunity of reconsidering their position at the last moment, and not attempt to bind them by the decision of their representatives on the Town Council many years before, taken in all probability under entirely different circumstances and frequently from mistaken views of the public interest.

If, before applying for a provisional order, the local authorities were bound to obtain the sanction of the ratepayers in the way provided for under the Borough Funds Act—in the case of the promotion of Bills in Parliament—the case would be somewhat different; but as no such provision exists, the responsibility of the Local Government Board to see that the Town Council is acting in harmony with the bulk of the ratepayers, at the crucial moment, is paramount.

A private company is required to obtain the consent of the local authority for its application for powers, and the action of the few men constituting a town council should be controlled in such an exceptional branch of municipal trading by the direct sanction of the ratepayers.

---

**Nitrides in Calcium Carbide.**—When the lime used in manufacturing calcium carbide is dolomitic (*i.e.*, contains magnesium compounds), the finished material always evolves a considerable quantity of ammonia when treated with water; and unless the gas is thoroughly washed in a separate vessel of water or dilute acid, or is evolved in an apparatus where a large excess of water is always present, ammonia passes with the acetylene to the burners, and is in several respects a nuisance. It is generally supposed that the ammonia is formed by the action of the water upon magnesium nitride ($Mg_3 N_2$), a compound which Rossel and Landriset appear to think is produced when magnesium carbide, formed in the electric furnace by the action of the coke upon the magnesia, comes in contact with the air. This explanation, however, requires revision, because, as Moissan has proved, magnesium carbide is so (comparatively) unstable that it is decomposed by the arc of a current of 600 amperes at 60 volts, and, like the carbides of sodium and potassium, cannot be prepared in the electric furnace. Quite recently Eidmann and Moeser have shown that magnesium nitride may be formed by heating metallic magnesium in air in contact with certain metals, their oxides, or their carbides. It seems possible, therefore, that when dolomitic lime is employed to manufacture calcium carbide, part of the magnesia is reduced to the metallic state like part of the lime, and in the act of cooling the metal absorbs nitrogen from the air, yielding its nitride, which eventually is decomposed by water to give ammonia. Rossel and Landriset have also detected ammonia in calcium carbide made from chemically pure calcium oxide and carbon; here they believe the traces of metallic calcium which find themselves at the outside of the cooling mass of carbide play the same part as the magnesium, taking up nitrogen, forming calcium nitride, and yielding ammonia to water. Thus the elemental calcium in the cooling material exerts a double influence; in protected situations it remains as metal, and eventually yields hydrogen; at the surface it forms a nitride, and finally yields ammonia. Maquenne described nitrides of the alkaline earth metals in 1892, but they were not made electrically (at least not immediately so). He considered them to be "somewhat volatile," but apparently meant at temperatures exceeding a dull red heat. He mentioned the calcium compound, but did not ascertain its formula, which was presumably $Ca_3 N_2$. It is desirable to distinguish carefully between these nitrides and the "calcium nitride" described by Dennis and Benedict in 1898. The latter has the formula $Ca N_6$, and explodes when heated. It is a derivative of the hydrogen nitride, having the composition $HN_3$, which is also called azoimide, and formerly nitrogen hydride or hydrazoic acid.

## LOCALISATION OF HIGH RESISTANCE BREAKS.

BY J. RYMER-JONES.

SEVERAL good tests are applicable for localising a rupture in a submarine cable when the fault has a small resistance, but so far as the writer is aware, no very satisfactory method has been published whereby the position of a high resistance break can be determined. The following test has been devised to meet this important desideratum.

Connect up as in fig. 1 with keys $K_1$, $K_2$, $K_3$ and $K_4$ in the positions shown, and a plug in the circular commutator between 1 and 2, and also the plug in the single way switch $p$.

*Preliminary Test to Obtain a Balance.*

Move both handles of $K_3$ over to left to put the *negative* pole of the testing battery through $K_1$ to the fork of the differential galvanometer G, having its coils $g_1$ and $g_2$ shunted by $U_1$ and $U_2$ respectively.

Adjust R for a balance, and as equilibrium is perfected increase the resistance of both the shunts equally as it is necessary to have a sensitive galvanometer for the subsequent capacity test when the broken cable is short.

The testing current must be suited to the resistance in circuit to reduce any unsteadiness due to fault polarisation as much as possible. Every change in the balance must be compensated by R, which should be a resistance with a sliding contact (not plugs) capable of being changed quickly without breaking the circuit, or if more convenient R may be a fixed high resistance and the balance obtained by adjusting the shunt on $g_2$. Both coils $g_1$ and $g_2$ should have *universal* shunts capable of being varied as desired.

Having made this preliminary experiment to obtain the approximate values to produce a balance, required when the capacity test is made later on, switch off the battery with $K_3$ and proceed to measure the

*Resistance of the Cable Conductor and Fault by Direct Deflection Method.*

Remove plug $p$ to break the circuit of $g_2$, and with other connections remaining unchanged, switch over both handles of $K_3$ again to the left to put the testing battery to the cable through $K_1$ and $g_1$ (shunted with an exceedingly low shunt) to obtain a suitable reading $d$ to be used for calculating the combined resistance, R $l$ of the cable conductor, fault, shunted coil $g_1$, and battery resistance $b$, by direct-deflection method. Note this reading, then depress $K_2$ to earth the cable charge for, say, 2 seconds. During this interval throw the handles of $K_3$ hard over to the right to take off the battery, then let $K_2$ rise. This puts the cable to earth through $g_1$ to enable the operator to read the *cable current* $\delta$. This must be added to, or subtracted from, $d$, according as it is on the opposite, or on the same, side respectively of the scale zero, in order to obtain the corrected deflection $d \pm \delta$, for calculating the true resistance, R $t$, of the cable circuit. The *constant* for this should be found, *after the cable tests are concluded*, by removing $l_3$ from terminal 9 and connecting it to terminal 10 of $l_2$, and also connecting $l_1$ to 7 (as shown by the dotted line), so that the current goes through $g_1$ (shunted with the same shunt as for the cable) and the resistance coils R which must be adjusted to give a suitable deflection D for the *constant* R D.

The true resistance of the cable circuit

$$\text{R } l = \text{R } \frac{\text{D}}{d \pm \delta} \text{ (ohms)} \qquad \text{and}$$

The true resistance of the cable conductor and fault

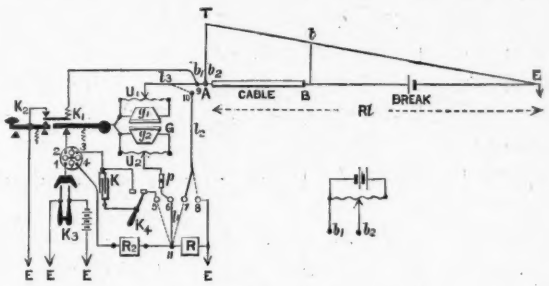
$$\text{R } l = \text{R } l - (b + g_1 \text{ shunted}).$$

*Static Charge held by the Cable.*

[To follow immediately after obtaining the direct deflection reading, $d$ and $\delta$.]

Next switch off the testing current, and alter the shunt on $g_1$ to the value previously employed for the trial balance. Retain the shunt on $g_2$ and also R as adjusted for the trial balance; and after re-inserting the plug in switch $p$, move both handles of $K_3$ over to the left to put on the testing current. When the galvanometer has settled down, after the first charging throw, re-adjust R to compensate any change in the original balance.

As soon as the balance is steady, quickly depress $K_2$, which by raising $K_1$ takes off the battery, and precisely at the same instant puts the junction between the coil $g$, and the cable, point 9, direct to earth, and thus discharges the static charge of the cable (due to the fall of potential when the battery was on) without affecting the galvanometer. After, say, 2 seconds, let $K_2$ rise. This takes off the earth and at the same instant puts on the battery. Although the *continuous* testing currents through $g_1$ and $g_2$ have been adjusted to equilibrate each other, the balance will be momentarily upset, at the instant of putting on the battery, by the charge taken up by the capacity of the cable which produces a throw (C). This should be noted, and also the multiplying power (S) of the shunt on $g_1$. If the throw be too large, reduce




FIGS. 1 AND 2.

the shunt values $U_1$ and $U_2$ used for the balance to make the galvanometer less sensitive. The testing current need only be kept on long enough to observe the throw, after which depress $K_2$ to take off the battery and discharge the cable, and then let $K_2$ rise to observe another throw. To prevent any disturbance of the galvanometer balance $K_2$ must be depressed very quickly indeed.

When several readings have thus been taken to verify C, take off the battery from $K_1$ by switching both handles of $K_1$ to the right. Should there be a marked difference in the observed values of C, keep on the testing current to check the balance. If the zero has changed much, re-adjust the balance and repeat the charge test, after which the resistance R $t$ should again be measured by direct deflection.

Taking out plug P, and keeping both handles of $K_3$ in the position shown, prevents the fault E.M.F. running down through the galvanometer when not testing.

*Condenser Constant ($c$).*

The condenser constant should be taken *after the cable tests* as follow :—

Put plug of commutator between 1 and 4 and 2 and 3, and remove plug P. Remove lead $l_3$ from terminal 9 to terminal 10 of $l_2$, the other end of which must be removed from 7, and earthed at 8, as shown by the dotted line; also remove $l_1$ from 6 and connect to 5.

Make resistance $R_2$ equal to $g_1$ *as shunted for the cable charge*, and alter R to equal $R_t$ as calculated by the previous direct deflection method.

Switch both handles of $K_3$ to the left to put on battery; then switch over handle of $K_4$ to the right to charge condenser K through $g_1$ (suitably shunted) from the junction (point 11) between $R_2$ and R, now equal to R $l$. The observed throw ($c$) is the same as would be obtained were the condenser charged at point 9, when the apparatus is connected up to measure the charge C into the cable while the continuous currents through the parallel circuits $g_1$ and cable, and $g_2$ and R were balanced, as explained further on. The charge throw ($c$) obtained with the standard condenser K multiplied by its shunt ($s$), and divided into the charge throw C also multiplied by its shunt value (S), gives the *measured capacity* ($f$) of the broken cable when charged by the mean of the potentials existing at its two ends, while the battery current is circulating through the above parallel circuits, in terms of the condenser capacity K, or $f = \text{K } \frac{\text{C S}}{c\ s}$ microfarads.

The potential in the cable branch falls regularly and in

## Localisation of High Resistance Breaks.—Table I.

Distribution and sum of the static charges in every 5 miles of a cable 1,000 miles long when its distant end is to earth and a permanent current circulating through it.

| Cols. | *i* | 1 | *h* | 2 | *g* | 3 | *f* | 4 | *e* | 5 | *d* | 6 | *c* | 7 | *b* | 8 | *a* | 9 | | 10 | — | Static charge. In 50 miles. | Static charge. In whole line. | Sum of charges in Col. 11. | Ratio $\frac{f}{F}$ | Length from testing end. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | 50th | 45 | 45th | 40 | 40th | 35 | 35th | 30 | 30th | 25 | 25th | 20 | 20th | 15 | 15th | 10 | 10th | 5 | 5th | | 11 | 12 | 13 | 14 | 15 |
| | MILES | | | | | | | | | | | | | | | | | | | | | | F. | F = 1,000,000 | F = 1. | Miles. |
| End to earth. | 2,500 | 25 | 2,475 | 75 | 2,400 | 125 | 2,275 | 175 | 2,100 | 225 | 1,875 | 275 | 1,600 | 325 | 1,275 | 375 | 900 | 425 | 475 | 475 | Sum = | 2,500 | 1,000,000 | 1,000,000 | 1·000000 | 1,000 |
| | 7,500 | 525 | 6,975 | 575 | 6,400 | 625 | 5,775 | 675 | 5,100 | 725 | 4,375 | 775 | 3,600 | 825 | 2,775 | 875 | 1,900 | 925 | 975 | 975 | ,, | 7,500 | | 997,500 | 0·997500 | 950 |
| | 12,500 | 1,025 | 11,475 | 1,075 | 10,400 | 1,125 | 9,275 | 1,175 | 8,100 | 1,225 | 6,875 | 1,275 | 5,600 | 1,325 | 4,275 | 1,375 | 2,900 | 1,425 | 1,475 | 1,475 | ,, | 12,500 | | 990,000 | 0·990000 | 900 |
| | 17,500 | 1,525 | 15,975 | 1,575 | 14,400 | 1,625 | 12,775 | 1,675 | 11,100 | 1,725 | 9,375 | 1,775 | 7,600 | 1,825 | 5,775 | 1,875 | 3,900 | 1,925 | 1,975 | 1,975 | ,, | 17,500 | | 977,500 | 0·977500 | 850 |
| | 22,500 | 2,025 | 20,475 | 2,075 | 18,400 | 2,125 | 16,275 | 2,175 | 14,100 | 2,225 | 11,875 | 2,275 | 9,600 | 2,325 | 7,275 | 2,375 | 4,900 | 2,425 | 2,475 | 2,475 | ,, | 22,500 | | 960,000 | 0·960000 | 800 |
| | 27,500 | 2,525 | 24,975 | 2,575 | 22,400 | 2,625 | 19,775 | 2,675 | 17,100 | 2,725 | 14,375 | 2,775 | 11,600 | 2,825 | 8,775 | 2,875 | 5,900 | 2,925 | 2,975 | 2,975 | ,, | 27,500 | | 937,500 | 0·937500 | 750 |
| | 32,500 | 3,025 | 29,475 | 3,075 | 26,400 | 3,125 | 23,275 | 3,175 | 20,100 | 3,225 | 16,875 | 3,275 | 13,600 | 3,325 | 10,275 | 3,375 | 6,900 | 3,425 | 3,475 | 3,475 | ,, | 32,500 | | 910,000 | 0·910000 | 700 |
| | 37,500 | 3,525 | 33,975 | 3,575 | 30,400 | 3,625 | 26,775 | 3,675 | 23,100 | 3,725 | 19,375 | 3,775 | 15,600 | 3,825 | 11,775 | 3,875 | 7,900 | 3,925 | 3,975 | 3,975 | ,, | 37,500 | | 877,500 | 0·877500 | 650 |
| | 42,500 | 4,025 | 38,475 | 4,075 | 34,400 | 4,125 | 30,275 | 4,175 | 26,100 | 4,225 | 21,875 | 4,275 | 17,600 | 4,325 | 13,275 | 4,375 | 8,900 | 4,425 | 4,475 | 4,475 | ,, | 42,500 | | 840,000 | 0·840000 | 600 |
| | 47,500 | 4,525 | 42,975 | 4,575 | 38,400 | 4,625 | 33,775 | 4,675 | 29,100 | 4,725 | 24,875 | 4,775 | 19,600 | 4,825 | 14,775 | 4,875 | 9,900 | 4,925 | 4,975 | 4,975 | ,, | 47,500 | | 797,500 | 0·797500 | 550 |
| | 52,500 | 5,025 | 47,475 | 5,075 | 42,400 | 5,125 | 37,275 | 5,175 | 32,100 | 5,225 | 26,875 | 5,275 | 21,600 | 5,325 | 16,275 | 5,375 | 10,900 | 5,425 | 5,475 | 5,475 | ,, | 52,500 | 1,000,000 | 750,000 | 0·750000 | 500 |
| | 57,500 | 5,525 | 51,975 | 5,575 | 46,400 | 5,625 | 40,775 | 5,675 | 35,100 | 5,725 | 29,375 | 5,775 | 23,600 | 5,825 | 17,775 | 5,875 | 11,900 | 5,925 | 5,975 | 5,975 | ,, | 57,500 | | 697,500 | 0·697500 | 450 |
| | 62,500 | 6,025 | 56,475 | 6,075 | 50,400 | 6,125 | 44,275 | 6,175 | 38,100 | 6,225 | 32,875 | 6,275 | 25,600 | 6,325 | 19,275 | 6,375 | 12,900 | 6,425 | 6,475 | 6,475 | ,, | 62,500 | | 640,000 | 0·640000 | 400 |
| | 67,500 | 6,525 | 60,975 | 6,575 | 54,400 | 6,625 | 47,775 | 6,675 | 41,100 | 6,725 | 35,375 | 6,775 | 27,600 | 6,825 | 20,775 | 6,875 | 13,900 | 6,925 | 6,975 | 6,975 | ,, | 67,500 | | 577,500 | 0·577500 | 350 |
| | 72,500 | 7,025 | 65,475 | 7,075 | 58,400 | 7,125 | 51,275 | 7,175 | 44,100 | 7,225 | 37,875 | 7,275 | 29,600 | 7,325 | 22,275 | 7,375 | 14,900 | 7,425 | 7,475 | 7,475 | ,, | 72,500 | | 510,000 | 0·510000 | 300 |
| | 77,500 | 7,525 | 69,975 | 7,575 | 62,400 | 7,625 | 54,775 | 7,675 | 47,100 | 7,725 | 39,375 | 7,775 | 31,600 | 7,825 | 23,775 | 7,875 | 15,900 | 7,925 | 7,975 | 7,975 | ,, | 77,500 | | 437,500 | 0·437500 | 250 |
| | 82,500 | 8,025 | 74,475 | 8,075 | 66,400 | 8,125 | 58,275 | 8,175 | 50,100 | 8,225 | 41,875 | 8,275 | 33,600 | 8,325 | 25,275 | 8,375 | 16,900 | 8,425 | 8,475 | 8,475 | ,, | 82,500 | | 360,000 | 0·360000 | 200 |
| | 87,500 | 8,525 | 78,975 | 8,575 | 70,400 | 8,625 | 61,775 | 8,675 | 53,100 | 8,725 | 43,875 | 8,775 | 35,600 | 8,825 | 26,775 | 8,875 | 17,900 | 8,925 | 8,975 | 8,975 | ,, | 87,500 | | 277,500 | 0·277500 | 150 |
| | 92,500 | 9,025 | 83,475 | 9,075 | 74,400 | 9,125 | 65,275 | 9,175 | 56,100 | 9,225 | 46,875 | 9,275 | 37,600 | 9,325 | 28,275 | 9,375 | 18,900 | 9,425 | 9,475 | 9,475 | ,, | 92,500 | | 190.000 | 0·190000 | 100 |
| | 97,500 | 9,525 | 87,975 | 9,575 | 78,400 | 9,625 | 68,775 | 9,675 | 59,100 | 9,725 | 48,875 | 9,775 | 39,600 | 9,825 | 29,775 | 9,875 | 19,900 | 9,925 | 9,975 | 9,975 | | 97,500 | | 97,500 | 0·097500 | 50 |
| | 50 | | 45 | | 40 | | 35 | | 30 | | 25 | | 20 | | 15 | | 10 | | 5 | | Testing end of Cable → | | | | | 0 |
| | MILES | | | | | | | | | | | | | | | | | | | | | | | | | |
| Cols. | *i* | 1 | *h* | 2 | *g* | 3 | *f* | 4 | *e* | 5 | *d* | 6 | *c* | 7 | *b* | 8 | *a* | 9 | | 10 | | | | | | |

Cols. 1 to 10 give the relative charges held by each 5 miles of every 50 miles of the whole cable.
Cols. *a* to *i* give the sum of the charges for each additional 5 miles of every 50 miles of the whole cable. The summing up is from the testing end towards the earthed end.

TABLE II.

| Distribution and sum of charges for every mile of the ten 5-mile lengths of the 50 miles nearest to the earthed end. | | | | | | | | | | Charge in the first ten 5 miles, 50 miles from earthed end. | | Length. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | see Table I. | | | |
| Cols. | *n* | 16 | *m* | 17 | *l* | 18 | *k* | 19 | *j* | 20 | 21 | 22 | 23 | |
| | MILES | | | | | | | | | | | | | |
| | 5 | 5th | 4 | 4th | 3 | 3rd | 2 | 2nd | 1 | 1st | | | Miles. | |
| End to earth. | 25 | 1 | 21 | 3 | 21 | 5 | 16 | 7 | 9 | 9 | Sum 25 | 2,500 | 50 — 45 | Earthed end. |
| | 75 | 11 | 64 | 13 | 51 | 15 | 36 | 17 | 19 | 19 | „ 75 | | 45 — 40 | |
| | 125 | 21 | 104 | 23 | 81 | 25 | 56 | 27 | 29 | 29 | „ 125 | | 40 — 35 | |
| | 175 | 31 | 144 | 33 | 111 | 35 | 76 | 37 | 39 | 39 | „ 175 | | 35 — 30 | |
| | 225 | 41 | 184 | 43 | 141 | 45 | 96 | 47 | 49 | 49 | „ 225 | | 30 — 25 | |
| | 275 | 51 | 224 | 53 | 171 | 55 | 116 | 57 | 59 | 59 | „ 275 | | 25 — 20 | |
| | 325 | 61 | 264 | 63 | 201 | 65 | 136 | 67 | 69 | 69 | „ 325 | | 20 — 15 | |
| | 375 | 71 | 304 | 73 | 231 | 75 | 156 | 77 | 79 | 79 | „ 375 | | 15 — 10 | |
| | 425 | 81 | 344 | 83 | 261 | 85 | 176 | 87 | 89 | 89 | „ 425 | | 10 — 5 | |
| | 475 | 91 | 384 | 93 | 291 | 95 | 196 | 97 | 99 | 99 | „ 475 | | 5 — 0 | |

Cols. 16 to 20 give the relative charges held by each mile of the above 50 miles.
Cols. *j* to *n* give the sum of the charges for each additional mile of a 5-mile length in the above 50 miles.
The summing up is from the higher to the lower potential *i.e.*, towards the earthed end.

950 miles.

Cols. *a* to *i* give the sum of the charges for each additional 5 miles of every 50 miles of the whole cable. The summing up is from the testing end towards the earthed end.

direct proportion to the resistance of the cable conductor and the fault resistance, but only the cable portion has any *capacity*; and it is on the value of the *measured capacity* $f$ in conjunction with the measured total resistance $R_l$ of the cable conductor plus the fault that this test for the distance of the break is based.

It might appear as though the charge C observed when a cable current exists would not be strictly comparable with the value $c$ obtained with the condenser, when no current traverses $R_2 + R\,l$, but this is not so as explained later on.

It will be evident that if the fault resistance be infinitely high, *i.e.*, the distant end of the cable sealed, the same potential which charges the condenser at point 9 (or at the junction between $R_2$ and $R_l$ which is the same thing), will charge the cable equally throughout its whole length, and as their measured charges are directly proportional to their relative capacities, the capacity of the cable $= K \frac{C\,S}{c\,s}$ as already stated.

If, on the other hand, the fault has no resistance, *i.e.*, makes *dead earth*, the potential fall is regular from a maximum, P, at the testing end to the distant end, E, where it is zero, and in this case the total charge taken up by the cable, owing to this fall, is only *half* what its capacity would be if its distant end were insulated, and it were charged throughout its length to the same potential, P.

Moreover, if we suppose a cable having its distant end earthed, to be divided into equal units of length, the distribution of static charges in each unit, due to the regularly falling potential, is known, *e.g.*, the first half has three times the charge of the distant half, and Tables I., II., and III., are constructed to give the relative charges held by every unit-length of such a cable.

Again, if the resistances of the conductor be equal to that of the fault, the potentials at the near and distant end of the cable conductor are respectively (say) 100 and 50, and, therefore, the cable portion takes up a charge, due to a mean potential of 75, which can be measured as already explained, while the remaining half of this circuit, viz., the fault, has no capacity for a static charge; and it is this fact, in conjunction with the effect, which the total resistance, R $l$, has in modifying the cable charge, and the known distribution of the charge held by every part of a cable having its distant end earthed, which has been taken advantage of to localise the distance of a high resistance break.

The higher the fault resistance the greater the charge in the cable, because the potentials in the cable portion of the circuit are higher. Moreover, the higher the fault resistance the more cells may be used to increase the charge. It will, therefore, be seen that a high resistance tends to increase the efficiency of the localisation, which depends on the charge being large enough to be accurately measured.

The lower the fault resistance the more advantageous is it to employ a rather low galvanometer resistance, and consequently the more sensitive the instrument can be made in other respects the better.

If the length of the cable in circuit be short, the momentary rush of current to charge it will be small, and it is for this reason that the shunt used for the balance has to be of such a value as will ensure a good readable charge throw.

TABLE III.

| Constants to be used with Table II. | | | | | Distance from the testing end. |
|---|---|---|---|---|---|
| $n^1$ | $m^1$ | $l^1$ | $k^1$ | $j^1$ | 24 |
| MILES | | | | | |
| 5 | 4 | 3 | 2 | 1 | |
| *nil* | *nil* | *nil* | *nil* | *nil* | From 1,000 to 950 miles. |
| 500 | 400 | 300 | 200 | 100 | „ 950 „ 900 „ |
| 1,000 | 800 | 600 | 400 | 200 | „ 900 „ 850 „ |
| 1,500 | 1,200 | 900 | 600 | 300 | „ 850 „ 800 „ |
| 2,000 | 1,600 | 1,200 | 800 | 400 | „ 800 „ 750 „ |
| 2,500 | 2,000 | 1,500 | 1,000 | 500 | „ 750 „ 700 „ |
| 3,000 | 2,400 | 1,800 | 1,200 | 600 | „ 700 „ 650 „ |
| 3,500 | 2,800 | 2,100 | 1,400 | 700 | „ 650 „ 600 „ |
| 4,000 | 3,200 | 2,400 | 1,600 | 800 | „ 600 „ 550 „ |
| 4,500 | 3,600 | 2,700 | 1,800 | 900 | „ 550 „ 500 „ |
| 5,000 | 4,000 | 3,000 | 2,000 | 1,000 | „ 500 „ 450 „ |
| 5,500 | 4,400 | 3,300 | 2,200 | 1,100 | „ 450 „ 400 „ |
| 6,000 | 4,800 | 3,600 | 2,400 | 1,200 | „ 400 „ 350 „ |
| 6,500 | 5,200 | 3,900 | 2,600 | 1,300 | „ 350 „ 300 „ |
| 7,000 | 5,600 | 4,200 | 2,800 | 1,400 | „ 300 „ 250 „ |
| 7,500 | 6,000 | 4,500 | 3,000 | 1,500 | „ 250 „ 200 „ |
| 8,000 | 6,400 | 4,800 | 3,200 | 1,600 | „ 200 „ 150 „ |
| 8,500 | 6,800 | 5,100 | 3,400 | 1,700 | „ 150 „ 100 „ |
| 9,000 | 7,200 | 5,400 | 3,600 | 1,800 | „ 100 „ 50 „ |
| 9,500 | 7,600 | 5,700 | 3,800 | 1,900 | „ 50 „ 0 „ |
| * | * | * | * | † | |

* To be added to the figures in their respective cols. of Table II.
† To be added to the figures in cols. 20 to 16 respectively according as it is the 1st, 2nd, 3rd, 4th, or 5th mile of the particular 5-mile length where the break is situated.

The rationale of the test is as follows:—

Let R $l$ be the total true resistance of the circuit (including the cable conductor, fault resistance, shunted galvanometer

coil, $g_1$ ($r$) and battery ($b$) resistances, as calculated by direct deflection method.

Then the resistance of the cable conductor and fault, R $l$ = R $l$ − ($r$ + $b$), as given above.

Consider this resistance, R $l$, as entirely made up of cable having a mean resistance, $r_1$, per N.M. of the whole cable as laid, and the mean capacity per N.M. as obtained from the factory value.

The length of this imaginary cable will be $\frac{\text{R } l}{r_1}$ or L knots; and the total capacity, with the distant *end insulated*, L $f_1$.

If the distant end of the imaginary cable be direct to earth, and the potential at the testing end maintained the same as when the distant end was free, the static charge held by the whole length L will be $\frac{\text{L } f_1}{2}$, or F microfarads, distributed in proportion to the falling potential from a maximum T at the testing end to zero at the distant end.

Consider this imaginary cable as divided into 1,000 equal parts, then the relative charge in each 50 kts. will be found in Table I. and Tables II. and III., enable the value of every unit into which every 50 kts. is sub-divided to be found.

In reality R $l$ is only partly made up of cable conductor A B, the remaining resistance B E being in the ruptured end which has no capacity. The fall of potential is, however, the same, and quite regular throughout the resistance R $l$, equivalent to L miles, whether it be wholly or only partly cable conductor.

By measuring, therefore, the static charge (C) held by the cable portion represented by the area A B $l$ T, and calculating therefrom its capacity $f$, we obtain the ratio between $f$ and the calculated total capacity F, which the imaginary cable would have if L miles long, and holding a charge represented by the area A E T.

The values of $f$ and F must here be understood to express only the *relative capacity* of the part, and whole of the cable respectively *to hold a static charge under the special conditions of the test.*

Having, therefore, obtained by measurement and calculation the ratio $\frac{f}{\text{F}}$, we are able to find by Tables I., II., III., the distance of the break from the testing end of a cable, *supposing it were* 1,000 *miles long.* The break will be at the same *proportional distance* in the cable of any other length. In the present instance the real length of the imaginary cable is L miles, therefore, the result obtained from the tables must be multiplied by $\frac{\text{L}}{1{,}000}$ to give the actual distance.

In Table I. the total charge represented by the area A E T is given as 1,000,000 (col. 13), and the relative charge for every 50 miles and 5 miles, and also the *sum of the charges* for each additional 50 miles and 5 miles are tabulated. Tables II. and III. enable the relative charge for every 5 miles or single mile, and also the *summed* values for the charges in these sub-divisions, to be readily found; so that by means of these three tables the calculated ratio $\frac{f}{\text{F}}$ (Table I., col. 14), can be converted into distance from the testing end.

*(To be concluded.)*

## ON ANODE RAYS.

By W. HIBBERT.

ABOUT three or four years ago, Dr. Gladstone and I conducted some researches on the absorption of X rays by various salts and metals. The experiments were very numerous and involved the use of many tubes, so that incidentally a great variety of observations were made. In some cases, pure accident led to some notes about anode rays which may interest your readers. M. Sagnac has given some account of similar results.

The X ray tubes employed were of the well-known form shown in the figures, the bulb being about 2½ in. in diameter, and the distance from the aluminium cup to the platinum plate about 1¾ in.

For the benefit of those who are less familiar with the subject, it will be convenient to describe the appearances observed during the process of exhausting these tubes, when an electric discharge from a coil is used. At a pressure which is relatively great, light appears around the cathode cup (fig. 3). With increasing exhaustion this light spreads more and more till a converging beam forms. The focus of this cone has a very considerable *depth*, but divergence over a large area follows (fig. 2). As the pressure still diminishes, the divergence cone narrows, until it all falls on the flat platinum plate. At still further exhaustion these cones disappear, and the greenish-yellow light which indicates the X ray stage

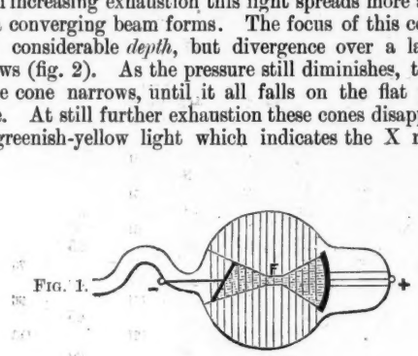


FIG. 1.

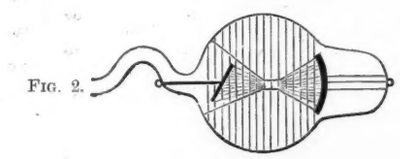


FIG. 2.

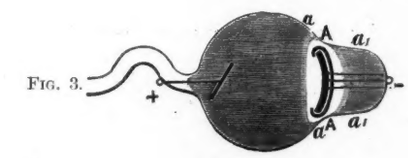


FIG. 3.

fills the whole space intervening between the electrodes. At various stages, the platinum plate (anode) is observed to get red hot, which is explained by the action of "cathode rays" from the aluminium cup bombarding the plate on which they are focussed, raising its temperature by delivering up to it the kinetic energy they possess.

While at work on these tubes, I had the good fortune to see the result of an excessively small puncture, so small, indeed, that the normal pressure was not restored in six hours. The main effects observed were the reverse of those just described as occurring during exhaustion. The greenish-yellow light disappeared; the fairly concentrated cones were followed by the more diffused; and after a little while, light could be seen round the aluminium cup only.

In this deteriorating vacuum I happened to reverse the current, just after the cones had disappeared, and the focus was becoming indefinite. The aluminium cup thus became an anode, and the platinum plate a cathode, contrary to the usual practice. To my surprise, the platinum cathode became red hot, and continued so during the discharge. Even when the battery was switched off, the incandescence was visible, dying away in the manner observed after bombardment by cathode rays. The current was reversed six or seven times, and each time that the platinum plate was acting as cathode it became red hot, though this was not observed when it was made an anode.

It is now granted that the ordinary incandescence of an anti-cathode, or anode, is due to bombardment by "rays" from the cathode. Parity of reasoning suggests that at the particular pressure reached in the experiments just described, the cup-shaped aluminium electrode can radiate anode rays more energetically than cathode rays.

As the leakage continued and the vacuum deteriorated still further, the visible heating of the platinum plate (cathode) diminished and finally ceased. But heating continued, for the bulb was found to be warm over a considerable area near the cathode. At a pressure at which the discharge showed light just round the aluminium cup as cathode (fig. 3), the current was reversed, and the heating

circuit are higher. Moreover, the higher the fault resistance

the cable conductor, fault resistance, shunted galvanometer

E



effects were greatest at A A, falling rapidly in front to *a a*, and less rapidly behind to $a_1 a_1$.

I now tried to obtain evidence of this anode radiation, and consequent incandescence of the cathode, during the process of exhausting a tube. Putting a tube on to a Cossor pump, and running steadily till an ill-defined "focus" appeared between the electrodes (the discharge being in the usual direction—aluminium as cathode, platinum as anode) the current was reversed, and at once the platinum plate began to glow. Here again the anode radiation or discharge is more energetic than that from the same end used as cathode.

Some observations were made during the process of exhaustion by touching different parts of the glass globe. Heating effects were observable over a wide range of pressure, and as soon as the vacuum became fairly good, the temperature was higher round the cathode than near the anode. It is, however, widely and irregularly distributed till a much lower pressure is increased. The bombardment is then concentrated on the cathode as described, raising it to incandescence. The pressure at which this was obtained was proved in various experiments to be just higher than that at which the "focus" becomes visible. In some experiments, the platinum was seen to heat first at a point or a very small area, recalling the experimental proof given by Mr. Campbell Swinton of a focal concentration continuing to the anode. Here, of course, the continuation is to the cathode.

These results seem to indicate that during exhaustion of a tube there are both anode and cathode rays, that the line of discharge and concentration for each varies according to the pressure, and that at particular, though different, pressures, it is possible to get convergence of either.

I hope to determine the pressures by the aid of Mr. Cossor's McLeod gauge.

## THE ELECTRICAL VOLUNTEERS.

One of the last acts of the late Dr. John Hopkinson was to set on foot the scheme for forming a corps of Electrical Engineer Volunteers. That was in 1896. What the corps has done in the five years that have followed is well known to readers of the Electrical Review on account of the frequent iteration in our columns of the story of the sterling service which has been rendered to the country and Empire by its officers and men. Quite recently it was announced that another 100 men had been dispatched to the field of battle, but while the sacrifice they made as individuals was equally as great as that of those who had already returned from the front, not quite the same degree of enthusiasm was evinced at the time of their departure. The situation in South Africa had changed enormously for the better, and the novelty of the electrical profession and industry sending its personal representatives to the front had, in a measure, worn off. But there is still some hard and useful work for the corps to do, and those who are now at the front will be wanting neither in courage nor in skill. While some of the men are still away in their country's cause, those who have already rendered such yeoman service in the thick of the fray were gathered together with the rest of the corps in London to ceremonially celebrate an interesting and significant development in connection with the corps.

We refer, of course, to the ceremony of opening by the Hon. Col. the Right Hon. Lord Kelvin, of the headquarters, which are situated in Regency Street, Westminster, on Saturday afternoon last. The company met in the Drill Hall. Major Erskine gave an account of the formation of the corps by Dr. John Hopkinson, who with 10 officers went for a course of instruction to the Isle of Wight to get a knowledge of the kind of work the corps would be required to perform. Since then the strength of the corps has gradually increased, its present strength being 494. The full complement is 580 (about). Until the present headquarters were built, the corps had been helped by several other Volunteer corps (1st Middlesex R.E., London Scottish and 2nd Fusiliers, &c.), who kindly placed their drill halls at the disposal of the corps, when possible. Detachments of the corps have been formed at Woolwich and Chelmsford, and large numbers of recruits come from the Central Technical College and the School of Mines.

Lord Kelvin, in a short speech, declared the headquarters open, and Mrs. Hopkinson presented to the corps a photograph of Dr. Hopkinson, the founder and first commanding officer of the corps.

Colonel R. E. Crompton spoke of the work done in South Africa by members of the corps, which the war had enabled to make great headway. Although much of the enthusiasm regarding the war had died out, the corps had been able, without difficulty, to send out another 100 men, which he regarded as a good proof of what would take place if the Electrical Volunteers ever had to be called out in home defence, the purpose for which it was originally formed. He stated that the war had now reached a stage when engineering played a large part in it. The last detachment of Electrical Engineers is already spread all over the country, and he had no doubt that they would do as well as the other detachments had done. He remarked that the corps had sent out a larger proportion of officers and men than any other volunteer corps.

Major Erskine expressed his gratitude to those who had come forward to enable the money to be raised for new headquarters. It was stated that Mrs. Hopkinson will be presented with a silver model of the searchlight which was used by the men in South Africa.

Colonel Crompton having proposed a vote of thanks to Lord Kelvin for coming to open the headquarters, visitors betook themselves to the inspection of the building and the new oil engine and dynamo, also the searchlight and carriage used in the war.

## ON POLYPHASE GENERATING AND SUB-STATION PLANT FOR ELECTRIC TRACTION.

By A. C. EBORALL.

In the Electrical Review for May 24th, 1901, there appears a short article by Mr. Hobart, on the subject of choice of type and periodicity for electric traction plant, which is of very considerable interest, for Mr. Hobart's experience in this direction is well known. The article in question deals with matters which have already been pretty well discussed in the present writer's recent Institution paper, but insomuch as several of Mr. Hobart's conclusions are contrary to what has been hitherto recognised as being the best practice in these matters, it is worth while examining some of the principal points again, for the subject is a most important one.

Mr. Hobart's principal point is that for electric traction work of an extended character where converting sub-stations are necessary, the employment of rotary converters is a mistake, and the use of these machines should be abandoned in favour of synchronous motor-generators operated at about eight cycles, for all future tramway schemes in which *slow speed* generating units are employed in the power station. Mr. Hobart comes to this conclusion simply on account of the parallel running troubles which may arise due to the greater cyclic irregularity of slow-speed engines, which he alleges require enormously heavy fly-wheels in order to reduce the cyclic irregularity (and with it the phase deviation) to the limits required for satisfactory parallel working; or which require, on the other hand, moderately heavy fly-wheels and damping coils (wasting considerable energy), on either the rotaries or generators.

Now with very few exceptions, all important tramway power stations are arranged with slow-speed generating units, for in spite of all that has been written and said in favour of high-speed engines, it cannot be denied that with regard to the points of economy and overload capacity, which are of first importance for any kind of power work, the slow speed engine still takes first place when work of large magnitude is in question. It is clear, therefore, that under these circumstances, the conclusions arrived at by Mr. Hobart merit very careful attention.

For reasons which will presently appear, the writer ventures to think that Mr. Hobart's conclusions are too sweeping, and that his arguments are open to severe criticicism. For it must be remembered that lighting work is not in question, but simply power work, and therefore the great advantage of synchronous motor-generators, namely, of excellent pressure regulation, very simply attained, hardly comes into consideration. In laying out a large power scheme for tramway purposes, the three principal considerations are reliability, economy of working, and large overload capacity, for a minimum expenditure, and as electrical knowledge and experience stand at present, there is no doubt whatever in the writer's mind that the best results will continue to be attained by following good modern practice in these matters. The leading features of the latter as they appear to him may be summarised as follows for tramway schemes of not less than 6,000 H.P. in magnitude :—

(*a*) *Power Station.*—Three-phase star connected fly-wheel type generators of not less than 1,500 KW. individual output, generating suitable high pressure current directly at 20—25 cycles. If laminated pole shoes, damping coils bridging them to be used.

Steam at 180 or 200 lbs. (preferably superheated) supplying compound or triple-expansion condensing engines.

The polyphase generators to be placed between the engine cranks, the cylinders being arranged in such a manner that this can be done. Speeds for 25-cycle plant about as follows :—

| | | | | | | |
|---|---|---|---|---|---|---|
| For | 1,500 | KW. | sets... | ... | ... | 88 r.p.m. |
| „ | 2,000 | „ | „ ... | ... | ... | 83 „ |
| „ | 3,000 | „ | „ ... | ... | ... | 75 „ |
| „ | 4,000 | „ | „ ... | ... | ... | 75 „ |

The exciters to be shunt wound and separately driven by high speed double-acting engines.

The switchboard to be arranged with oil switches and fuses (or blow-out circuit breakers); the speed of each engine to be controlled from the corresponding machine panel, in order to facilitate switching the sets in parallel; a small three-phase motor to be mounted on each engine for this purpose.

All auxiliary plant, as far as possible, to be motor driven.

The steam consumption of main engines at full load to be 10·5 to 11·5 lbs. per I.H.P.-hour, according to type, steam pressure, amount of superheating, &c. Governing of these engines to be so arranged, that if half full load be suddenly switched on or off, the speed will not vary more than 2 per cent. The weight of magnet wheel to be such, that the phase displacement at any load does not exceed 2°.

The generator efficiency ($\cos\phi = 1$), including ventilation and excitation losses, but excluding friction of bearings (credited to engine), to be not less than 95 per cent. at full load, and 92—93 per cent. at half load. Pressure drop at constant speed and excitation 5—6 per cent. ($\cos\phi = 1$), and 16—18 per cent. ($\cos\phi = 0{\cdot}8$). Temperature rise of any part not to exceed 70° F. after 24 hours' full non-inductive load. Excitation loss at full load not to exceed 1 per cent. ($\cos\phi = 1$), or 1·75 per cent. ($\cos\phi = 0{\cdot}8$). Pressure test for armature insulation as follows :—

| | | | | |
|---|---|---|---|---|
| For | 5,000-volt | armatures | ... ... | 10,000 volts. |
| „ | 8,000 | „ | ... ... | 13,000 „ |
| „ | 10,000 | „ | ... ... | 15,000 „ |

the (alternating) pressure being applied for 30 minutes between winding and frame.

The middle points of the (star connected) armature windings, if the feeders are underground, to be well earthed; otherwise not.

*b. Feeders.*—Paper insulated, three-core, laid on solid system, or else in ducts or directly in the ground. If the former (and if in this country), the cast-iron troughs should be bonded; if the latter, the lead covering or steel sheathing (as the case may be) should be well earthed at frequent intervals. These precautions, of course, are prescribed by the B.O.T. The distance between any one core and the lead covering not to be less than the distance between any two cores; the latter is determined by the maximum pressure, and by the B.O.T. rule.

If the cables are not laid in (bonded) iron troughs, it may pay, in order to conform to Board of Trade rules with minimum outlay, to put on a thin copper taping directly under the steel sheathing, which would consequently also be well earthed and connected to the middle points of the armature windings. Failing this, an earth wire (or equivalent) will generally have to be arranged for.

All the high pressure cables to be provided at generating station and sub-station ends (and also at other places, if possible) with suitable safety discharge apparatus (such as modified "horn" type lightning arresters), so that the cables and generator armatures and transformer primaries will not be damaged should the circuit be suddenly broken with current on.

(*c*) *Sub-Stations.*—Each to have a complete rotary converter equipment. Air blast (not oil cooled) step-down transformers, with duplicate blower equipment. If underground feeders, the windings on both sides to be star connected, with middle point of primary windings well earthed; if overhead feeders, the windings to be mesh connected on both sides, unless the pressure between line conductors exceeds 10,000 volts.

Each rotary converter to have its own step-down transformers, arranged with six-phase connection.

Full load efficiency of transformers to be 97·5—98 per cent. ($\cos\phi = 1$); at half load, 96—96·5 per cent. ($\cos\phi = 1$). Full load pressure drop at constant primary pressure, 1—1½ per cent. ($\cos\phi = 1$); 4½—5½ per cent. ($\cos\phi = 0{\cdot}8$). Temperature rise after 24 hours' full non-inductive load, 80° F.

Compound-wound six-phase rotary converters with auxiliary reactance coils (if necessary), and shunt regulators; sub-divided field windings. Speeds for 25 cycles as under :—

| | | | | | |
|---|---|---|---|---|---|
| For | 500-KW. | rotaries | ... ... | ... | 300 r.p.m. |
| „ | 750 | „ | ... ... | ... | 250 „ |
| „ | 1,000 | „ | ... ... | ... | 250 „ |
| „ | 1,500 | „ | ... ... | ... | 215 „ |

Each rotary to be provided with suitably placed damping coils.

Efficiency (including losses in damping coils, assuming that the phase displacement of the generators given above is not exceeded) to be 96—95 per cent. at full load, 93·5—93 per cent. at half load, according to size. Temperature rise as for generators, except for the commutators, which may have 80° F. rise; no sparking with fixed brushes up to 100 per cent. overload; overload capacity, 50 per cent. for four hours, and 100 per cent. for short periods without sparking, over-heating, hunting, or falling out of step.

The starting of the first rotary to be effected preferably by means of a small auxiliary asynchronous motor-generator installed in each sub-station, fed by a step-down transformer; other rotaries on the system to be started from the first one.

(*d*) *General.*—Spare plant and cables to be carried throughout to the extent of about 20 per cent.

The above short summary of the lay-out of a large traction scheme does not call for much comment, for it represents good standard practice. A few words may be said, however, regarding the relative amounts of fly-wheel effect in the generator magnet wheels asked for by different engine makers in order that the given cyclic irregularity may not be exceeded, for this point has a direct bearing on Mr. Hobart's argument and conclusion already quoted.

The electrical contractor, when asking for offers of suitable engines for driving his polyphase generators, will state the maximum cyclic irregularity he can permit in order that satisfactory parallel running of generating and sub-station plant may be ensured. The amount of the permissible cyclic irregularity varies with the nature of the work, for it is dependent upon the permissible phase displacement. If the generators have to supply rotary converter sub-stations, the phase displacement of the generator E.M.F. wave should not exceed 2·5°, according to Mr. Hobart, or 2° according to the writer, for thoroughly satisfactory working. Thus a point on the rotating magnet-wheel of the generator may not differ more than $\frac{2{\cdot}5}{p}\left(\text{or } \frac{2}{p}\right)$ from the position it would have if the rotation was perfectly uniform, "$p$" being the number of pole pairs. Now it is surprising to find what a large difference there is between the requirements of different engine builders in order to keep within the permissible figure, even when engines of precisely similar type are under consideration.

As an illustration the writer may cite a case that recently came under his notice, as it serves also to bring out another point, namely, the marked superiority of Continental slow-speed engines for work of this kind. For a certain 5,000-H.P. engine running at 80 revolutions three different offers were received, two from well-known English makers of high repute, one from one of the very best Continental makers; in each case it was specified by the electrical contractor that the generators should be between the cranks, and that the cyclic irregularity should not exceed 0·2 per cent. up or down, while in each case the type of engine was left open to the tenderer. The two English firms tendered for engines of precisely the same type (three-crank tandem compounds) stipulating in the one case (*a*) that a fly-wheel effect of 13,000 foot-tons should be provided, and in the other case (*b*) that a fly-wheel effect of about 8,000 foot-tons should be arranged for in the magnet-wheel, in order that the above-mentioned cyclic irregularity should not be exceeded. On the other hand, the Continental maker asked for a fly-wheel effect of only 6,000 foot-tons, for a *smaller* cyclic irregularity, namely, 0·15 per cent. up or down; the engine offered in this case was a triple-expansion four-crank engine with four cylinders, and the guaranteed steam consumption at all loads was very much better than that guaranteed by the English builders for the compound engines.

(*To be continued.*)

## MUNICIPAL ENTERPRISE.

IN an article which positively teems with good sense and sound argument, the *Times* of June 1st gave utterance to some very pronounced views upon the subject of municipal trading, illustrated by reference to electricity as applied for lighting and tractive purposes. Not only have the old arguments against the municipalisation of tramways, &c., been set forth in a clear and readable fashion, but others, not often enough considered, are to be found in the columns of the *Times*. So valuable are they that a careful study of the article will be worth the while of all who are interested in, or opposed to, the more modern phases of municipal enterprise. That the craze is assuming alarming proportions appears from a fact stated by Lord Avebury last year, in his address to the London Chamber of Commerce, when he said that, among the businesses which corporations are now seeking to undertake were to be found banking, pawnbroking, coal supply, saddlery, manufacture of electrical fittings, and of the residual products of gas. Cold storage is one of the latest ventures.

The *Times* articles deal (*a*) with the municipal supply of electricity for lighting purposes; (*b*) the municipal ownership of electrical tramways within and without the district of the local authority; (*c*) the attitude of the local authorities towards the electric power schemes which engaged the attention of Parliament during the last session, and concludes with a forcible argument *against* municipal trading of the modern type.

After stating the oft-repeated arguments against the *veto* which, under the present *regime*, a local authority can place upon the acquisition of an electric lighting order by a private company, the *Times* correspondent refers to these startling facts:—(1) Lord Cross's committee in their report expressed the opinion that although the local authority should be entitled to be heard before the Board of Trade, they should not have a provisional veto; (2) that there are over 200 local authorities in the British Isles at present holding provisional orders which have never been put into force!

In the face of such revelations it is difficult to understand why the existing law is not forthwith amended. We, in our humble sphere, have always insisted upon the necessity for the change adumbrated by Lord Cross's committee. Time has shown that principles which were applicable to gas and water cannot be safely applied to the law of electricity; and in extending the period of compulsory purchase by the Act of 1888, the Legislature has itself recognised this solemn truth. Can Ministers of the present day be brought to realise that private enterprise, unhampered by the interference of local Bumbles, is the sovereign remedy for the tardiness hitherto displayed in the adoption of electricity?

We regard that part of the *Times* article which deals with the wisdom of allowing the local authority to work trams outside its own area as worthy of the greatest attention. It is pointed out that the ratepayers' money is necessarily used for the laying down of such tramways; that in the case of a municipal Corporation undertaking the work those who use the tramways for the most part reside outside the district, and do not contribute to the rates. If it is unjust that the Corporation should arrogate to itself the profit accruing from trams outside their district, it is surely unfair that the losses of adventures far afield should be borne by the ratepayers.

The illogical attitude of Parliament is well illustrated by a glance at a few of the private Bills which are passed in the course of a year. Upon some local authorities are conferred unfettered powers to make a profit out of their trams, and to dispose of that profit as they think fit, while others have been compelled to devote all their profits to cheapening fares and working expenses. It is the proud boast of Leeds, and other towns in the north of England, that large sums are annually written off against the rates, but anyone who has studied the evidence before private Bill committees can testify to the difficulties which have beset the Corporation of Leeds, not to mention other towns, in dealing with neighbouring local authorities through whose districts they have endeavoured to extend their tramways.

Another strong argument against opening the municipal door to trading is forcibly emphasised by the *Times*. This is the Public Authorities Protection Act, 1893, which was passed in 1893 to prevent unnecessary and vexatious litigation against a local authority. All actions of this nature must be brought within six months, and if the plaintiff comes off second best he has to pay the costs of the local authority as between solicitor and client. Granted that such a rule is just in its application to protect the highway authority and other bodies whose duties are of an essentially public nature, we can only regard it as working a great hardship when applied to the multifarious duties which, in modern times, and with Parliamentary sanction, the local authorities have taken upon themselves.

Taking a broad view of the situation, the chief difficulty which arises when electric tramway systems become vested in the local authority is the reluctance which they display to enter into an accommodation with neighbouring local authorities or private companies. A large private company not being confined within municipal boundaries, can extend its operations throughout a wide district, and is in a position to connect together a number of the smaller towns which are to be found in the large manufacturing districts in the north of England. Take the case of the South Staffordshire Tramways Bill in 1899. There the British Electric Traction Company sought powers to lay down a number of lines through Walsall and a number of other towns in South Staffordshire. For this purpose it was necessary for them to buy up the undertakings of several small private companies. The scheme was opposed, and that successfully, by a number of local authorities, who talked vaguely of uniting among themselves to form a complete tramway system when the time should arrive for so doing. The fact that this argument influenced the minds of the Committee is all the more surprising when we learn that the periods for compulsory purchase all elapsed at different times in the various districts, so that unification was rendered practically impossible.

**Electric Launches.**—His Majesty the King has, as the Czar of Russia did before him, extended his patronage to the electric launch as the best means for seeing the beauties of the Thames. There will now doubtless be increased activity in electric launch apparatus business as a direct result, to meet the demand among wealthy English families who will, by this act of his Majesty, learn that electricity is the right power for the propulsion of small launches.

## EXPERIMENTS IN WIRELESS TELEGRAPHY WITH THE GUARINI AUTOMATIC REPEATER.

BRUSSELS—MECHLIN—ANTWERP.

(*Continued from page* 872.)

ON January 19th M. Guarini, with the assistance of Lieut. Poncelet, attempted to obtain direct communication between Brussels and Antwerp, and *vice versâ*. The antenna of the Brussels station, which was in charge of Lieut. Poncelet, was placed on the Congress Column (fig. 5). That of the

FIG. 5.

Antwerp station, which was controlled by M. Guarini, was placed on the tower of the Cathedral of Notre Dame (fig. 6).

The distance between the two monuments, placed by the Belgian Government at the disposal of M. Guarini for the carrying out of these experiments, is 41 km. in a straight line. Along this straight line we find (fig. 7) several suburbs and towns, and hills of a maximum height of 69 metres above the sea level.

The base of the Congress Column is placed at an altitude of 48 m., and its summit, where the antenna terminates, is 94 metres above the sea level.

This combination was arranged at each station in such a manner, that in the corresponding part of the other one there was a simple cable (fig. 8).

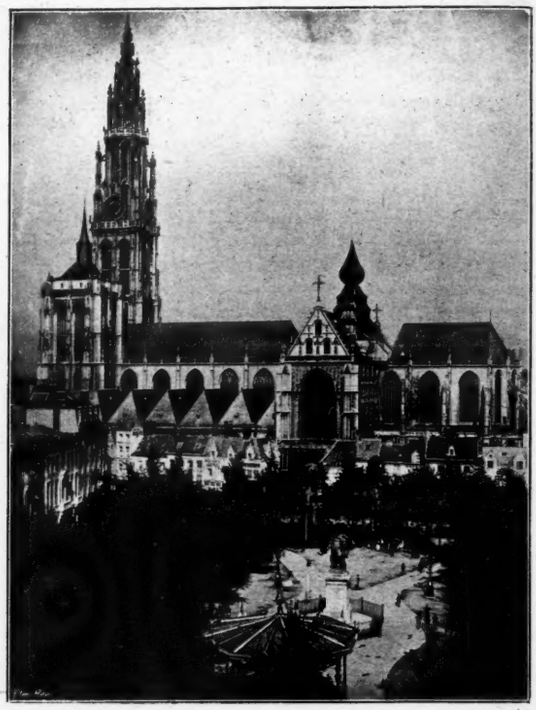
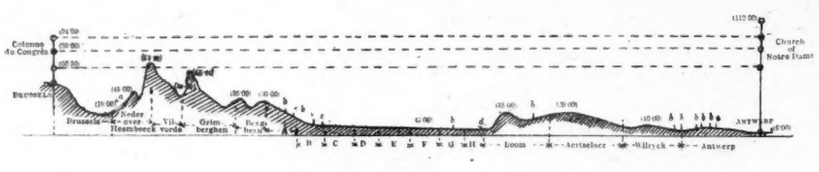


FIG. 6.

M. Guarini experienced some difficulty in the installation of the Antwerp station on account of the somewhat pyramidal form of the tower of Notre Dame. The antenna at Antwerp was supported by a kind of monster fishing-rod, composed of two series of three bamboo rods, held together by iron rings. These bamboo rods were fixed to the third gallery of the tower, and were supported by shrouds fixed to the fourth gallery.

From the extremity of the bamboo rods hung seven wires, $\frac{9}{10}$ths of a millimetre in diameter, interrupted in their course by the cylinder already mentioned. These wires descended as vertically as possible to the roof of the church, *i.e.*, to about 40 metres from the ground; the third gallery is 106 metres above the level of the square, and 112 metres above the level of the sea. Here the antenna takes a sharp turn, and proceeds to the instruments placed in a house in the environs. The connection to earth, consisting of a strand of three wires $\frac{4}{10}$ths of a millimetre in diameter, was connected with a gas lamp in the Place Verte.




A, Commune de Humbeek; B, Commune de Nieuwenroode; C, Commune de Capelle-au-Bois; D, Commune de Hombeek; E, Commune de Heffen; F, Commune de Blœsveld; G, Commune de Willebroeck; H, Commune de Blœsveld; *a*, Château Royal de Leeken; *b*, wood; *c*, canal; *d*, le Rupel; *e*, enclosure.

FIG. 7.

The Brussels antenna descended to 2 metres above the ground, and was connected with instruments placed in a house on the environs. The connection to earth was effected by means of the gas mains.

The antenna, both at Brussels and at Antwerp, consisted of a cylinder 10 metres in length, formed of 50 parallel wires, the diameter of the cylinder being 50 centimetres.

The receiver employed at the two stations was an ordinary receiver enclosed in a case of sheet-iron (fig. 9). For facility of transport, the Morse instrument was placed with a resistance coil in a wooden case.

The coil used at the transmitter was capable of giving a maximum spark of 25 centimetres. The distance between the balls of the oscillator was $1\frac{1}{2}$ cm. The current used was

9 amperes under a pressure of 16 volts. Fifty signals were transmitted in the two directions. Two signals were

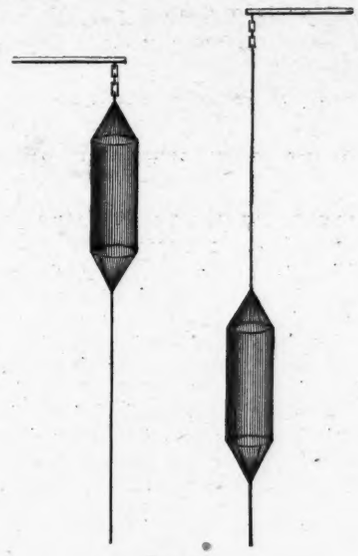


FIG. 8.

received at Brussels, where there was an extra sensitive Blondel coherer. No signal was received at Antwerp. The sparks with a duration of 30 seconds each, but without earth connection, to the Antwerp transmitter (fig. 10).

As the electric trams of the Rue Royale (continuous current traction with underground mains) pass at a few metres distance from the Congress Column, observations were taken by Lieut. Poncelet to see if the coherer was sensibly affected at the starting. The results were negative.

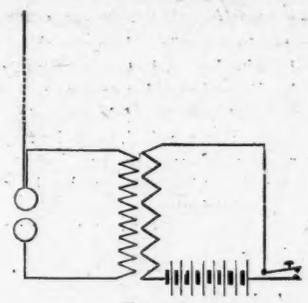


FIG. 10.

M. Guarini did not wish to pursue further his experiments in direct communication between Brussels and Antwerp, as this was not his ultimate object. It would not have been difficult to establish communication between these two towns, as the ground between them is much more level than between Brussels and Mechlin. M. Guarini did not so much seek to establish communication between these two towns as to endeavour to find the maximum range of his

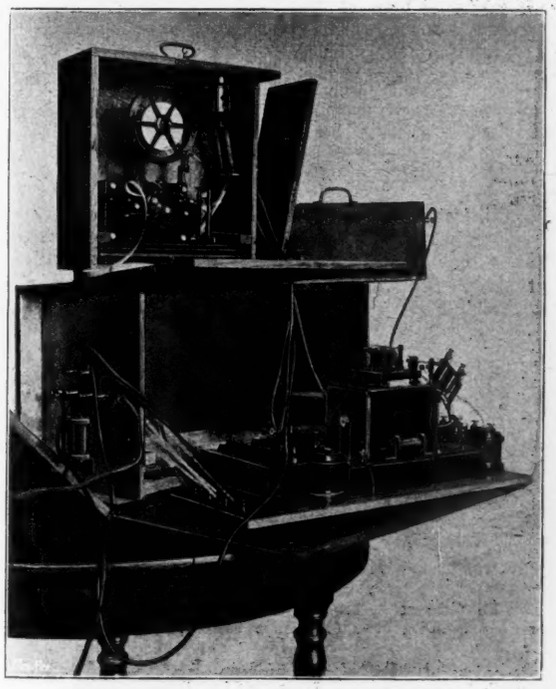


FIG. 9.

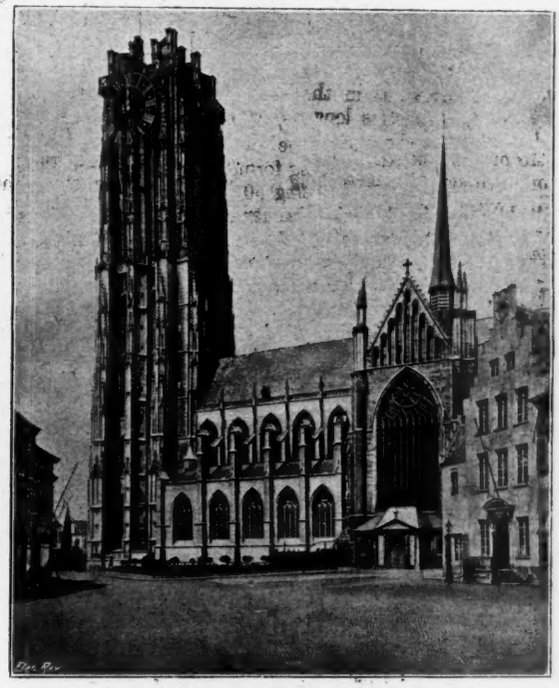
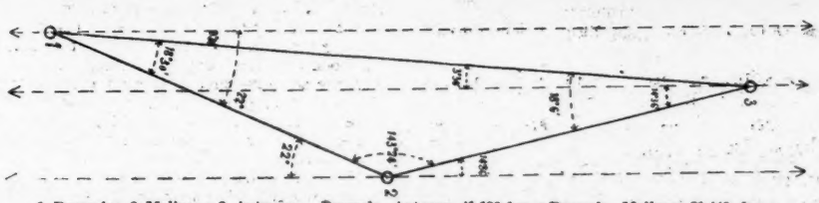


FIG. 12.



1, Brussels; 2, Malines; 3, Antwerp. Brussels—Antwerp, 41,190 km.; Brussels—Malines, 21,440 km.; Malines—Antwerp, 21,920 km.; Brussels—Malines—Antwerp, 43,360 km.

FIG. 11.—POSITION OF THE THREE TOWNS—BRUSSELS — MALINES—ANTWERP.

two signals at Brussels were received when, towards the end of the communication, M. Guarini transmitted two long instruments. His sole object was to test at great distances his repeating apparatus, with which up to that time he had

only made laboratory tests. An intermediate station was then established at Mechlin on St. Rombaut's Tower, and a series of preliminary experiments was made between this town, Brussels and Antwerp. These three towns are so situated as to constitute the three points of a scalene triangle (fig. 11).

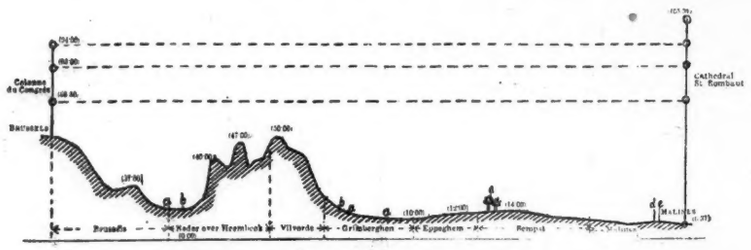
On January 25th M. Guarini established wireless telegraphic communication between the Congress Column at Brussels and St. Rombaut's Tower at Mechlin (fig. 12).

The distance between these two points is 21 km. The electric waves passing straight between these two localities, crossed several suburbs and towns such as Schanbeek, Haren, Vilverde, Eppeghem, between the northern part of Brussels and the southern part of Mechlin (fig. 13).

The base of St. Rombaut's Tower is 6 metres, and its summit 105 metres, above the sea level. The antenna terminates at 94 metres above the sea level.

M. Guarini established communication, although the upper part of the antenna at Mechlin, which had become detached from its support in a gale, had fallen down more than 15 metres, and was caught on the projections of the Tower in several places.

The useful part of the antenna—the visible part—was 27·50 metres in length. The antenna, both at the transmission station at Brussels and at the receiving station at




*a*, la Senne; *b*, Canal de Willebroeck; *c*, wood; *d*, canal; *e*, boulevard.

FIG. 13.

Mechlin, consisted, as in the Brussels-Antwerp experiment, of a cylinder 10 metres long formed of 50 parallel wires, the diameter of the cylinder being 50 centimetres, and arranged at each station in such a manner that in the corresponding part of the other there was a simple cable. Thus, for instance, at Brussels the cylinder began at 80 metres and at Mechlin at 70 metres above the level of the sea.

The communication was interrupted when, at Mechlin, M. Guarini let the antenna down to 69 metres above the sea level, *i.e.*, to the level of several houses in Brussels round

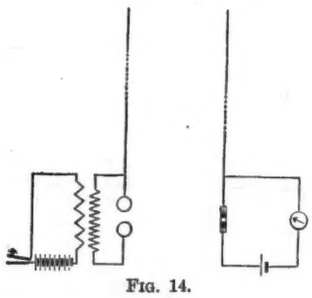


FIG. 14.

about the Congress Column, the mean height of these houses being 18 metres.

This proves, according to M. Guarini, (1) that the antenna transmits radiations in planes normal to its axis; (2) that obstacles, such as houses, if they are numerous, completely stop the electric radiations.

The maximum length of spark of the coil used was 25 centimetres.

The most interesting observation made in the course of these experiments is that the transmitter and the receiver with coherer, about which there was nothing special, were not in communication with the earth or with any capacity (fig. 14). One of the balls of the oscillator on the one hand and one of the electrodes of the coherer on the other were connected with the antennæ; while the other ball of the oscillator and the other electrode of the coherer were entirely free. M. Guarini concluded that the electric waves are not propagated through the earth, and that they do not follow the curvature of the earth.

(*To be continued.*)

## EDISON'S NEW STORAGE BATTERY.

WE are indebted to the courtesy of the editor of our New York namesake for advance proofs of a paper on Edison's Storage Battery, by Dr. Kennelly, read at the annual meeting of the American Institute of Electrical Engineers.

Mr. Edison, says our esteemed contemporary, "has produced no invention of broader utility in the electrical field. It is hard to foresee all the meaning of this improvement. But we may look a little way and see the noiseless city, the suppression of the horse, and the automobile a factor of economic importance in general transportation. The perfected battery means the solution of many difficult traction problems, the betterment of electric lighting, and the foundation of the new art of electric navigation. Electric tugboats will give new life to our canals, and with electric ferryboats, will revolutionise our harbours. Electric torpedo boats of swiftness and secrecy will make present naval armaments of doubtful protection.

"The invention gives electricity a new foothold in its career of industrial conquest."

While we think that Dr. Kennelly has rather minimised the capabilities of the storage battery of to-day, we believe also that it will be well to let the lapse of time tell its tale upon the new cells before accepting everything he says on the long sought and urgently needed light storage battery as gospel. But here is the paper, and accumulator experts can judge for themselves:—

I take pleasure in bringing to the notice of the Institute, this evening, a novel type of storage battery, recently invented by Mr. Edison.

In practice, the storage energy per unit mass of the modern lead battery, is from four to six watt-hours per pound of battery (8·8 to 13·23 watt-hours per kilogramme). Expressed in another way, a battery weighs from 124·5 to 186·5 lbs. per horse-power-hour at its terminals (75·5 to 113·4 kilos per kilowatt-hour).

While it is possible to increase the energy per unit mass by making the electrodes very light, yet this is always found to be followed by a very heavy deterioration.

Many attempts have also been made to perfect storage cells of the alkaline-zincate type, but the great difficulty of depositing zinc in coherent form from the solution, as well as the lack of a depolarizer that shall be insoluble in the electrolyte, has stood in the way of this cell's success.

Mr. Edison set himself the task of finding a cell which should possess the following advantages:—

1. Absence of deterioration by work.
2. Large storage capacity per unit of mass
3. Capability of being rapidly charged and discharged.
4. Capability of withstanding careless treatment.
5. Inexpensiveness.

He believes that the cell here shown may claim these advantages in a very satisfactory degree.

The negative pole or positive element, corresponding to the zinc

of a primary cell or the spongy lead of a secondary cell, is iron. The positive pole or negative element, corresponding to the carbon of a primary cell or lead peroxide of a secondary cell, is a superoxide of nickel believed to have the formula $NiO_2$. The cell is therefore a nickel-iron cell, a name which suggests the structural material—nickel-steel. The electrolyte is potash; viz., an aqueous solution containing from 10 to 40 per cent. by weight, but preferably 20 per cent. of potassium hydroxide, the freezing temperature of which is 20° below zero Fahrenheit or—30° Centigrade.

The initial voltage of discharge after recent charge is 1·5 volts. The mean voltage of full discharge is approximately 1·1 volts. The normal discharging current rate per unit area of active element (positive or negative) is 60 $\frac{\text{milliamperes}}{\text{sq. inch}}$, or 8·64 $\frac{\text{amperes}}{\text{sq. foot}}$, or 0·93 $\frac{\text{amperes}}{\text{sq. decimetre}}$. The storage capacity of the cell per unit of total mass of the cell is 14 watt-hours per pound or 30·85 watt-hours per kilo. Expressing the same statement in another way, the weight of battery per unit of electric energy at terminals is 53·3 lbs. per electrical horse-power-hour, or 32·4 kilos per kilowatt-hour. The mean normal discharging power-rate per unit mass of total cell is 4 watts per pound or 8·82 watts per kilo, corresponding to a normal discharge period of 3½ hours. The cell may, however, be discharged at a relatively high rate, in approximately 1 hour, corresponding to a discharging power-rate per unit of total cell mass of 12 watts per pound or 26·46 watts per kilo. Charging and discharging rates are alike. That is to say, the cell may be charged at the normal rate in 3½ hours; or, it may be charged at a relatively high rate in 1 hour, with no apparent detriment beyond a somewhat lowered electrical charge efficiency. In other words, the cell does not appear to be injured by over-charging or discharging, and only suffers in electrical efficiency under such treatment.

The positive and negative plates are mechanically alike, and can scarcely be distinguished by the eye. They differ only in the chemical contents of their pockets. The samples here exhibited, which are intended for automobile batteries, illustrate the construction. Each plate is formed of a comparatively thin sheet of steel, 0·024 in. (0·61 mm.) in thickness, out of which rectangular holes are stamped, so as to leave a grid or frame somewhat resembling a window-frame. In the plate here shown there are three rows of eight such rectangular holes or recesses, or 24 recesses in all.

Each opening or recess is filled with a pocket or shallow box containing the active material. These boxes correspond to the panes of glass in the window-frame analogy. The panes instead of being thinner than the frame, as in an actual window, are thicker than the frame, or project slightly beyond the surface of the steel grid. They are perforated with numerous small holes to admit the electrolyte, but entirely conceal the contained active material from view. All that meets the eye, therefore, in any of the plates, is the steel frame and its embedded "windows" of perforated steel.

The active material is made in the form of rectangular cakes or briquettes, and one such briquette is lodged in each pocket or "window pane" of the plate. Each of the plates shown, therefore, supports, or contains, 24 briquettes of active material, all in rigid contact with its own substance.

Each briquette is placed in a shallow, closely fitting nickel-plated box of thin perforated crucible steel, cut from a long strip of that material 0·003 in. (0·075 mm.) thick. A cover or lid of the same material is then laid over it, so that the briquette is closely enveloped by the sides and walls of its perforated steel box. The boxes are then placed in the openings or holes in the nickel-plated steel grid, and closely fit the same. The assembled plate is then placed in a hydraulic press, and subjected to a total pressure of about 100 tons. This pressure not only tightly closes the boxes, but it also forces their metal sides over the adjacent sides of the recesses in the steel grid, thus clamping the whole mass into a single solid and rigid steel plate with the hollow "window panes" full of active material. The nickel-plating of both grids and boxes aids in securing good permanent electric connections between them. The finished plate has a grid thickness of 0·024 in. (0·56 mm.), and a "window" or pocket thickness of 0·1 in. (2·5 mm.). This is the maximum thickness of the plate at any point, but being of steel, the plate has ample rigidity.

The positive briquettes (zincs of a primary cell) are made by mixing a finely divided compound of iron obtained by a special chemical process with a nearly equal volume of thin flakes of graphite. The graphite does not enter into any of the chemical actions, but assists the conductivity of the briquettes. The graphite is divided into very thin laminæ by a chemical process, and these are passed through sieves or screens so as to leave a size or area of flake that is much larger than the area of the perforation in the steel windows. The mixture is then pressed into briquettes in a mould, under a hydraulic pressure of about two tons per square inch. The briquettes have a surface area of nearly 3 in. by one ½ in. on each face.

The negative briquette (carbon of a primary cell) is made by similarly mixing a finely divided compound of nickel, obtained by special chemical means, with a nearly equal bulk of fine flakes of graphite and solidifying the mixture in a mould into briquettes of the same size as above.

A suitable number of positive and negative plates are assembled together, being separated from one another only by a thin sheet of perforated hard rubber.

The assembled plates are placed in a vessel or external containing-cell of sheet steel containing the potash solution, which, of course, does not attack steel. There was, however, much difficulty from the action of the potash on the soldered seams of the steel containing-vessel. After many trials, however, Mr. Edison found a solder which seems to be entirely unaffected by the alkali.

In charging, the current is, of course, sent into the positive pole and its attached negative nickel plate, through the electrolyte, and into the positive plate of the iron compound which carries the negative pole. This current deoxidizes or reduces the compound to spongy metallic iron, and carries the oxygen through the film of electrolyte to the nickel compound, oxidising it to the hyper-oxide of nickel $NiO_2$, a higher oxide than the peroxide. In other words, the charging current simply carries oxygen in the opposite direction against the forces of chemical affinity, from the iron to the nickel, and stores the energy in the reduced iron, which is, of course, unaffected and passive in the presence of the potash solution. On discharge, the current passes from the positive pole through the external circuit to the negative pole and its attached iron or positive plate, and then through the solution to the negative, or superoxide plate. In so doing, the oxygen moves back against the current and partially reduces the nickel superoxide $NiO_2$, while oxidizing the spongy iron. The energy of burning of the iron and oxygen which would be developed as heat in the ordinary chemical process is now liberated in the circuit as electrical energy.

The cell is an oxygen lift. Charging pulls the oxygen away from the iron, and delivers it temporarily to the nickel. The condition is then stable, until the circuit of the cell is completed. Discharge then allows the oxygen to fall back from the nickel to the iron with the natural affinity of iron and oxygen.

In the new Edison cell, on the other hand, the theoretical action of the potash solution is merely to provide the proper channel through which the oxygen ions may travel in one direction or the other—positive plate to negative plate in charge, and negative plate to positive plate in discharge. Consequently, the amount of solution needs only to be sufficient to fulfil mechanical requirements. It is believed that the weight of solution will in practice be only about 20 per cent. of the plate weight or about 14 per cent. of the cell weight. In fact the cell may be worked in the same manner as the so-called primary "dry cells." Moreover, if the solution should escape, or be carried away, by gasing in charging, the only detriment seems to be the loss of active surface thereby occasioned, and it will only be necessary to fill up the cells to the proper level with water from time to time as evaporation or gasing may lower the level. For the same reason the specific gravity of the electrolyte does not appreciably vary during charge and discharge.

The briquettes of active material slightly expand on receiving oxygen, and slightly contract on delivering it, that is to say, the iron briquettes contract and the nickel briquettes expand during charge, while on discharge the iron briquettes expand and the nickel briquettes contract. The level of the solution is in this way scarcely affected. The expansions and contractions of the briquettes appear to be well within the elastic limits of the spring-steel containing-boxes, and consequently the electric contact is always secure. The covers or sides of the window pockets merely approach to or recede from each other slightly during charge and discharge. Fortunately, steel is a metal which possesses this mechanical elasticity in a marked degree.

The action of the charging and discharging current upon the briquettes seems to be transferred from their external surfaces inwards in a manner similar to the transfer of carbon and oxygen in the process of making malleable cast-iron in the furnace on the principle of cementation. No active material has been found to be ejected from the briquettes through the window perforations, even under deliberate over-charging and discharging. Such gas as is thereby produced makes its appearance on the external surface of the windows.

If the nickel compound had no affinity for oxygen, so that energy was neither developed nor absorbed in the deoxidation or further oxidation of that substance, then the energy would be entirely that due to the energy of combination of oxygen and iron, stated to be 79·7 watt-hours, and representing an electromotive force, theoretically obtainable, of 1·47 volts. If the combination of oxygen with the nickel compound be exothermic or energy-releasing, then the watt-hours delivered (and the electromotive force) will be lessened by the energy necessarily paid back to break up the combination.

If, on the other hand, the combination is endothermic, or energy-absorbing, then the watt-hours delivered (and the electromotive force) will be increased by the energy restored on breaking up the combination. Since the superoxide seems not to have been known hitherto, no information concerning its energy of combination is obtainable. The electromotive force of the cell seems to be so near to that of the union of iron and oxygen as to suggest that the nickel superoxide is not far from being neutral, or that the nickel compound has but little affinity for oxygen, although the superoxide appears to be quite stable in the cell.

The new cell does not seem to be appreciably influenced by changes of temperature, and should stand a very low temperature without detriment. The electrolyte—potash—does not attack any or the ingredients of the cell, nor are any of the ingredients soluble therein. No local action occurs in the cell so far as has yet been observed, since the electromotive force is below that necessary to decompose water.

The cell may be fully discharged to the practical zero point of electromotive force without detriment. In fact, a cell has not only been completely discharged, but recharged in the reverse or wrong direction, and after bringing it back to its originally charged state by proper restoration of the direction of charging current, the storage capacity remains unaffected. It would seem, therefore, that the cell should be capable of withstanding much abuse.

Mr. Edison states that "the negative plate (nickel) either charged or discharged, can be removed from a working cell and dried in the air for a week without appreciably injuring it, and when the plate

is finally replaced in the cell its charge is practically undiminished."

The positive (iron) plate, if similarly removed from the cell, will be likewise uninjured, but it soon loses its charge by the oxidization of the spongy iron with accompanying liberation of heat and appreciable rise of temperature extending over a period of several hours. On replacing the electrode, however, in the cell the storage capacity is unaffected on recharge.

As regards cost, Mr. Edison believes that after factory facilities now in course of preparation have been completed, he will be able to furnish the cells at a price per kilowatt-hour not greater than the prevailing price of lead cells.

Having now considered the action and properties of the cell, a brief description may be given of the difficulties encountered in developing it.

The phenomenon of passivity has probably kept inventors from finding this cell in the past. Mr. Edison believes that of all the very numerous compounds of iron, and of which he has tried many hundreds, the particular compound which he prepares is perhaps the only one capable of being used.

If the dried hydrates or oxides of iron, native or artificial, are subjected to electrolytic reducing action in any alkaline solution, they remain inert and unaffected.

On the other hand, if finely divided iron, obtained by reducing a compound of iron under the action of a reducing agent, such as hydrogen or carbonic monoxide, is subjected to electrolytic oxidization in an alkaline solution it is inert and cannot be oxidised. It assumes the well-known passive state.

The same difficulty of passivity affects the use of nickel or the negative element. Finely divided nickel, reduced from a nickel compound, remains inactive when subjected to electrolytic oxygen in an alkaline solution. The monoxide and the black-oxide or peroxide are also inert. No oxide of nickel is active, or can be made active by electrolytic action, and the peroxide does not act as a depolarizer.

The discussion which followed, in which Messrs. Mailloux, Steinmetz, Reber, Torchio, Dr. Keith, C. J. Reed, Entz, Hering, Lloyd and others participated, developed facts of unusual interest. Numerous questions were propounded, to all of which Dr. Kennelly made some reply. In one or two instances, as, for instance, the questions regarding the probable drop of internal resistance in the battery, or how the drop in discharge voltage was manifested, he was compelled to reply that he did not know exactly, not possessing full data on the matter.

## CORRESPONDENCE.

### Storage Battery Traction.

One cannot fail to have noticed of late the many and varied casualties (fatal and otherwise) that have occurred in various parts of the country, due to the adoption of overhead trolley lines for tramway traction; such casualties having no respect of persons, whether it be the man whose practical experience should make him careful, or whether it be the innocent pedestrian or the engrossed business man, &c., &c.

Although our present knowledge of the causes, dangers, and manipulation of electricity has, no doubt, a marvellous advantage in the development of its adaptation to almost everything one can mention, yet there are limits to such knowledge, for obviously "everyone" cannot be born to be an "electrician," and thus thousands must pass through life, not ignorant, yet as innocent as though electricity had never been heard of and did not exist around them.

It cannot be disputed that overhead systems are "certainly dangerous" from many points other than that of the electrical alone, and it must also be admitted that, made as ornamental as possible, yet it does not add to the general appearance of any town.

I am perfectly certain that the most satisfactory method of tram or railroad propulsion is that of a local storage battery on each car, or train of cars, and that nothing whatever will beat it. Why, then, should it not excel?

The greatest obstacle to its adoption has been the enormous cost of the batteries and the maintenance of them in renewals.

My suggestion is that the tramway companies would be taking a step in the right direction towards very greatly reducing this expenditure if they were to obtain a license from the patentees of whatever type of cell they intend to adopt, and manufacture their own plates on their own works, at first cost.

I do not see any reason why the patentees should raise any objection, as a royalty on the plates (or per ton of plates) so manufactured could be mutually agreed upon, and, of course, suitable clauses would be inserted to prohibit the tramway company from selling the plates, such manufacture being for the company's use *only*.

With regard to the cost of works plant required, I would strongly recommend a "Planté" type of plate for three reasons, viz.:—

1. That the plant required is not nearly so large and intricate, or expensive, as that of the "Faure" or pasted type.

2. That for traction work "Planté" plates are much more durable, although much heavier than the Faure plates.

3. That the plates, being made of pure lead (and not alloyed), the refuse from old plates would have a commercial value.

So far as my experience has gone, there is not any great obstacle in the question of the *weight* propelled, but that it confines itself to *cost* of outlay and *maintenance*, and for large tramway companies a very great saving would be effected.

"Electric storage traction" is by no means "squashed," as many would lead us to imagine, and the rapidly increasing number of automobiles tend to prove this fact, and open up a great possibility for the future.

Undoubtedly a very great number of the trials with storage batteries in this country have failed signally, but there are always two sides to every question, and it is very doubtful as to what was the cause of failure, viz., (1) the high prices and cost of maintenance; (2) the treatment of the cells; (3) the stability and durability of the plates.

At first sight the world of storage battery makers will strongly object to the suggestion of license, but I fully believe that, honestly speaking, they will admit it as a solving of the problem to both their own and the general public's advantage. The positions are naturally antagonistic to the success of "battery traction," for when a traction company buy cells they must secure themselves by obtaining a guarantee for the cells and a rate of maintenance from the suppliers in order to realise their expenses.

On the other hand, the suppliers have to risk the battery not receiving proper attention, and they secure themselves against *possible* contingencies, which may, perhaps, never occur, and it is obvious that both sides are opposed or unwilling to trust the other.

But if the patentees receive a royalty with no responsibility or risk, and the traction company obtain their material at first cost and unlimited renewals. I see no reason why both sides should not be in the best possible position, and thus bestow a boon on the general public by its adoption, as a safe means of locomotion, and the removal of the overhead system, and also the tearing up of roads for the underground systems, as in this case cables will be conspicuous by their absence.

Of course small tramway lines of only one or two cars would not appreciate the advantage, but the larger ones, which would require possibly a good many batteries per annum would fully realise the advantage.

I trust this suggestion may fall into good hands and be carefully considered, as I firmly believe it will tend to remove great difficulties that have hitherto been a "damper" on "Storage battery traction."

R. W. V.

[Our correspondent seems to be unaware that his suggestion of tramway companies being their own manufacturers has been made before, but is it likely they could produce cells equal to those made by the people who devote their time and skill to that purpose? Perhaps the Edison storage battery, described on another page, is destined to solve the problem.—EDS. ELEC. REV.]

### The Dudley and Stourbridge Tramway Power House.

I wish to correct a correction which appeared in the REVIEW for the current week in an article entitled, "Points in the Design of Electric Power Plants." The author states that "Dudley and Stourbridge is credited with three cross-compound 100-KW. engines for a track of six miles, whereas

the track is really about three miles, the other three miles being run on current purchased from the Dudley Corporation station."

Early last year this might have been true, except for the engines which are still tandem compound, but at the date of Mr. Dawson's paper, of which the article is a criticism, the Dudley and Stourbridge Company supplied 12 miles of track, leaving about nine miles to be supplied by the Dudley Corporation.

**Robert N. Tweedy.**

Harts Hill, Brierley Hill,
*June 22nd*, 1901.

## LEGAL.

### GWYNNE AND ANOTHER *v.* MEDICAL ELECTRO-THERMIC GENERATOR COMPANY AND ANOTHER.

IN the King's Bench Division of the High Court of Justice on Wednesday the trial of this action came before the Lord Chief Justice and a special jury. The plaintiffs were Mrs. Agnes Gwynne and her husband, Mr. John Gwynne, of Kenton Grange, the Hyde, London, and they sued the Medical Electro-Thermic Generator Company, Limited, of 2, Staple Inn, and Mr. Arthur Edwin Greville, of the same address, to recover damages for personal injuries said to have been caused by the defendants or their servants while administering an electric bath to Mrs. Gwynne. The defendant company were the proprietors of the Greville medical electro-thermic generator, of which the defendant Greville is the inventor, and he is also the managing director of the defendant company. The defendant company pleaded that there had been no negligence on the part of their servants, and that there had been contributory negligence on the part of the female plaintiff. The defendant Greville pleaded, in addition, that there was no cause of action against him. Mr. Macaskie, K.C., and Mr. Walter S. Glynn appeared for the plaintiffs; Mr. Jelf, K.C., and Mr. Alexander H. Carrington for the defendant company, and Mr. G. Spencer Bower for Mr. Greville.

In opening the case, MR. MACASKIE said the plaintiffs claimed damages for a most lamentable mischief which happened to the female plaintiff during the course of the administration of a newly-invented bath to which she was subjected with her consent some time on April 7th, 1899. Her husband, Mr. Gwynne, was a member of the well-known engineering firm of J. & H. Gwynne, and the defendants were a company whose business was to apply their treatment to patients. The peculiarity of the treatment was the application of immense heat to portions of the human body, which for that purpose were enveloped in a bath or cylinder. He believed in some cases the heat applied rose as high as 400° F., which was nearly twice the temperature of boiling water. The heat was developed by means of electricity. In April, 1899, Mrs. Gwynne was suffering from an obscure form of spinal disease, which had now been ascertained to be curvature of the spine and softening of the spinal cord. Eminent surgeons, including Dr. Broadbent, had been consulted, and by the advice of her doctor she made a trial of the defendant's system. Two baths were taken in which only the patient's legs were treated, without any evil effects, but on the occasion of the third bath, when the whole of the lower portion of the patient's body was dealt with, the defendants did not supply the proper wrappings, and in consequence of their representative, the son of Mr. Greville, not making proper inquiries, Mrs. Gwynne sustained severe burns, which laid her up for some time and caused her much suffering. In the course of the correspondence it was suggested that the defendant's representative was not allowed to examine the manner in which Mrs. Gwynne had been prepared for the bath by means of towels, but the plaintiff's case was that he should have inquired and satisfied himself definitely before he turned the electric current on. Instead of doing that he, however, only asked if she was comfortable and all right.

HIS LORDSHIP (to Mr. Macaskie): Will you tell me how the heat is applied? Is it by wires which run round?

MR. MACASKIE: Yes. I understand it is so.

MR. JELF: We have one of the apparatus outside. We can bring it into Court at once.

HIS LORDSHIP said he thought that course would be convenient, and the apparatus was brought in.

HIS LORDSHIP: At what voltage were the amperes applied?

MR. MACASKIE: I think it was at about 104. He then read the evidence of Mrs. Agnes Gwynne taken on commission, which was to the effect that in February, 1899, she came to stay at the De Vere Hotel, in London. She then had a slight cold, and called in her doctor. He advised her to take electrical baths. Her husband disapproved of them, but she had two baths against her husband's wishes. She had the first on March 28th, 1899, when one of Mr. Greville's men and a nurse were present. The bath was satisfactory. She had a second bath a day or two afterwards. Old Mr. Greville was present and a nurse. Pads were sent and stockings. Her doctor said that a course of the baths was desirable for her. Eventually she had a third bath on April 7th, 1899. She had no pads, but she had lint stockings on, and towels down the sides of the legs. She asked Mr. Greville, jun., if she was all right, and he said she was, some few minutes afterwards the electricity was turned on, and it became so hot that she could not stand it. The bath lasted from 15 to 20 minutes. At the end of the bath, Mr. Greville, jun., asked her if she was satisfied. She thought she said she was all right. She felt very bad after Mr. Greville left, and went to bed. She remained ill for three months, and never left her bed. The blisters which ensued were very painful. She now felt the effect of the burns.

DR. ALEXANDER FINDLATER, examined by MR. MACASKIE, said that prior to April, 1899, he had medically attended Mrs. Gwynne. She suffered from a spinal affection for two years before the accident. On April 8th the lady complained of burning and pain in the lower part of the body, and this gradually developed. In May he thought the lady would lose her life. The skin on the surface of the burns had not yet healed. He thought that the shock had done considerable injury to the lady's general health.

DR. BLASSON, of 23, Seymour Street, Portland Square, examined, said he had advised Mrs. Gwynne to take a course of baths, and the witness generally corroborated the evidence of the last witness as to the nature of the injuries the lady had received. The witness stated that he had a high opinion of those baths. If the padding had been properly done he believed the bath in question would have been as successful as the two previous baths which Mrs. Gwynne had.

PROF. VICTOR HORSLEY, F.R.S., examined, said he had examined Mrs. Gwynne about three months after the accident. She suffered from a spinal disease of some standing. He found a large partly healed wound on the lady. He considered that the accident depressed her condition, and caused her suffering.

MR. JOHN GWYNNE, one of the plaintiffs, and the husband of Mrs. Gwynne, examined, said he opposed his wife having the baths. He did not think that the baths agreed with her. After the second bath Mrs. Gwynne was very much exhausted. Mr. Greville assured him that there was no danger in the baths, and that if they did Mrs. Gwynne no good, they could not possibly do her any harm. On receipt of that assurance, he did not object to his wife having a course of the baths.

The hearing was adjourned.

### THE CUBA SUBMARINE TELEGRAPH COMPANY, LIMITED, *v.* THE WEST INDIA AND PANAMA TELEGRAPH COMPANY, LIMITED.

IN the Court of Appeal on Wednesday, before Lords Justices Rigby, Collins and Romer, Mr. HALDANE, K.C., mentioned this case, which had been argued and decided on appeal during the last sittings. Learned counsel stated that a difficulty had arisen in the drawing up of the order. Their Lordships had put a certain construction upon the words "telegraphic communication," and as to that both parties were really agreed, but on other points relating to matters of serious importance there was a question whether the order as drawn really carried out the judgment of the Court.

MR. EADY, K.C., on the other side, said the real question was as to the language in which the injunction granted was to be expressed.

Lord Justice RIGBY said he would consult with his learned brothers and fix a day on which the points at issue might be argued.

### BRITISH ELECTRIC WORKS COMPANY, LIMITED.

IN the Companies' Winding-up Court on Wednesday, before Mr Justice Wright, the petition of Messrs. Samuel Walker, Limited, for the compulsory winding up of the British Electric Works Company, Limited, was down for hearing.

MR. EVE, K.C., said the matter had stood over for a month in order to enable a scheme of reconstruction to be perfected. He was instructed that that had not yet been done, and that both parties were agreed that there should be another adjournment. There was already a voluntary winding-up, and under it the reconstruction would be dealt with.

HIS LORDSHIP granted an adjournment for another month.

## BUSINESS NOTES.

**Books Received.**—"Journal of the Institution of Electrical Engineers for May." Edited by W. G. McMillan. London E. & F. N. Spon, Limited. 4s.

"Central Station Experiences," reprinted from "Power." New York: The Power Publishing Company. 1901.

"Electrical Designs," reprinted from the "American Electrician." New York: American Electrician Company. 1901.

**Copper.**—Messrs. H. R. Merton & Co.'s fortnightly copper statistics again illustrate the rule of an alternate rise and fall. The drop recorded two weeks ago, both in stocks and visible supplies, is partly corrected now by an advance of 455 tons in the former and 480 tons in the latter. The total decline on balance since the beginning of the year is, therefore, 1,608 tons in stocks and 1,629 tons in supplies. The approximation of the present figures of stocks to those for the corresponding dates of 1900 and 1898 is very striking, a margin of 50 tons covering the differences.—*Financial Times.*

**Fire.**—A fire broke out at the Victoria Works of Messrs. Johnson & Phillips, at Charlton, on Monday afternoon, resulting in a building of one floor, 100 ft. by 40 ft., being partly burnt out, considerable damage being done to buildings, plant and stock. We understand, however, that the fire will not cause any delay in execution of orders, as the firm are able to utilise other portions of their extensive premises to carry on the work.

## Electrical Wares Exported.

| WEEK ENDING JUNE 5TH, 1900. | |
|---|---|
| Alexandria .. .. .. | Value £218 |
| Amsterdam .. .. .. | 305 |
| Bangkok .. .. .. .. | 74 |
| Beira. Teleg. mat. .. .. | 101 |
| Bombay .. .. .. .. | 291 |
| ,, Teleg. mat. .. .. | 49 |
| Boulogne .. .. .. .. | 20 |
| Buenos Ayres .. .. .. | 217 |
| ,, Teleg. wire .. | 54 |
| Calcutta .. .. .. .. | 286 |
| ,, Teleg. wire .. .. | 507 |
| Cape Town .. .. .. .. | 281 |
| Chinde .. .. .. .. | 144 |
| Colombo .. .. .. .. | 110 |
| Copenhagen. Teleg. mat. .. | 104 |
| Durban .. .. .. .. | 74 |
| Gibraltar. Teleg. mat. .. .. | 25 |
| Gothenburg .. .. .. .. | 11 |
| Hamburg. Teleg. mat. .. .. | 400 |
| Hankow .. .. .. .. | 20 |
| Hiogo .. .. .. .. .. | 90 |
| Ly ieton .. .. .. .. | 75 |
| Madras .. .. .. .. | 370 |
| Ostend .. .. .. .. | 350 |
| Riga .. .. .. .. .. | 82 |
| Rio Janeiro .. .. .. .. | 30 |
| Rotterdam. Teleg. wire .. | 38 |
| Rouen .. .. .. .. | 76 |
| St. Petersburg .. .. .. | 430 |
| Shanghai .. .. .. .. | 715 |
| ,, 25 tons old teleg. wire | — |
| Singapore. Teleg. mat. .. .. | 482 |
| Sydney .. .. .. .. | 779 |
| ,, Teleg. mat. .. .. | 1,910 |
| Tokio .. .. .. .. | 88 |
| Valparaiso .. .. .. .. | 119 |
| Total .. | £8,855 |

| WEEK ENDING JUNE 4TH, 1901. | |
|---|---|
| Adelaide .. .. .. | Value £198 |
| Aden. Teleg. cable .. | 108,520 |
| Alexandria .. .. .. .. | 131 |
| Amsterdam .. .. .. .. | 117 |
| Bangkok .. .. .. .. | 227 |
| ,, Teleg cable .. .. | 1,646 |
| Beira. Telephones .. .. | 17 |
| Brisbane .. .. .. .. | 36 |
| Buenos Ayres .. .. .. | 475 |
| ,, Teleg. mat. .. | 639 |
| Calcutta .. .. .. .. | 416 |
| Callao Teleg. cable .. .. | 975 |
| Cape Town .. .. .. .. | 73 |
| ,, Teleg. mat. .. | 21 |
| Copenhagen. Teleg. wire .. | 134 |
| Durban .. .. .. .. | 1,151 |
| ,, Teleg. mat. .. .. | 1,862 |
| Fremantle .. .. .. .. | 1,968 |
| ,, Teleg. cable .. | 819 |
| ,, Teleg. mat. .. | 21 |
| Gibraltar. Teleg. apparatus .. | 60 |
| Halifax. Teleg. cable .. .. | 3,000 |
| Hamburg .. .. .. .. | 50 |
| ,, Teleg. mat. .. .. | 380 |
| Hiogo .. .. .. .. | 32 |
| Hong Kong .. .. .. .. | 84 |
| Kure. Teleg. cable .. .. | 1,098 |
| Lisbon .. .. .. .. | 150 |
| Madras .. .. .. .. | 10 |
| Malta .. .. .. .. | 60 |
| ,, Teleg. mat. .. .. | 60 |
| Melbourne .. .. .. .. | 786 |
| Nagasaki .. .. .. .. | 51 |
| New York .. .. .. .. | 184 |
| Odessa .. .. .. .. | 75 |
| Oporto .. .. .. .. | 15 |
| Ostend .. .. .. .. | 173 |
| Santa Cruz .. .. .. .. | 91 |
| Shanghai .. .. .. .. | 120 |
| ,, 75 tons teleg. wire .. | — |
| Singapore .. .. .. .. | 29 |
| Sydney .. .. .. .. | 571 |
| ,, Teleg. wire .. .. | 770 |
| Valparaiso .. .. .. .. | 167 |
| Vigo. Teleg. mat. .. .. | 58 |
| Wellington .. .. .. .. | 1,326 |
| Total .. | £129,036 |

## Foreign Goods Transhipped.

| | |
|---|---|
| Rio Jane'ro. 25 tons teleg. wire | — |
| Stockholm. Telep. .. | Value £70 |
| Total .. | £70 |

| | |
|---|---|
| Brisbane. Teleg. apparatus | Value £638 |
| Durban. 30 cwt. telep. wire .. | — |
| Fremantle. Elec. machinery .. | 1,804 |
| Total .. .. | £2,442 |

**Bankruptcy Proceedings.**—A general meeting of creditors was held at the London Bankruptcy Court on May 31st, under the failure of John Evelyn Liardet, Hyde Park Gate, who has been engaged in experiments with, and developing, marine, electrical and hydraulic patents. The particulars of the failure have frequently appeared in these columns, both in relation to the debtor's public examination and to the scheme of arrangement entertained by the creditors. The chairman said an order of adjudication had now been made against the debtor, and the business of the meeting was to appoint a trustee and committee of inspection to wind up the estate in bankruptcy. After some discussion, Mr. Flaxman Haydon, chartered accountant, Union Court, Old Broad Street, E.C., was appointed to the post of trustee, and a committee of inspection was also elected. The statment of affairs filed under the proceedings, shows liabilities £5,647 6s. 9d., and assets valued at £19,000. Mr. C. E. Soames appeared for the debtor, and Messrs. Green & Tapp for creditors.

**Liquidation.**—A meeting of R. Waygood & Co., Limited, will be held at Falmouth Road, Great Dover Street, S.E., on July 2nd, to hear an account of the winding-up from the liquidator.

**Catalogues and Lists.**—As we mentioned a week or two ago, the Bullock Electric Manufacturing Company and the Wagner Electric Manufacturing Company, of America, have consolidated their sales departments. A formal announcement is being made in a neat little pamphlet with the title "A Step Forward."

Messrs. Taylor & Challen, Limited, of Birmingham, have issued a circular of their double-crank press for cutting-out, stamping and embossing sheet metal.

Mr James Littauer, of Cross Street, E.C., sends us his latest priced lists of several types of fan motors for direct and alternating current; also small motors and speed regulators.

Messrs. Allan & Adamson, Limited, of Ashstead, Surrey, send us a couple of circulars of their "Allan" accumulators.

The G.E. Co, Limited, has issued its 1901 list of "Freezor" electric fans for direct and alternating currents and for public and other buildings. Illustrations and prices of desk, bracket, ceiling and other fans are shown.

Messrs. D. Bruce Peebles & Co., of Edinburgh, have brought out a good list, in which they lay before the reader views and description of the various departments of their works where the manufacture of electric motors, generators and other machinery is carried on. A thick enamelled paper, careful arrangement of the letterpress and blocks, and good printing give the catalogue an appearance of substantiality. The opening page contains an array of the names of electrical stations and factories where P.P.P. plant is working. A general specification of the motors from 1—150 B.H.P. is given. Sizes, weights, prices, and so on, are stated in tabulated form. Multipolar generators from 10—500 KW. are also detailed, and they are illustrated combined with Willans, Belliss, Browett, and Sentinel type engines. Balancers for three or five-wire systems, crane motors and controllers of crane work (6—80 B.H.P.), motor-driven pumps and fans, plating dynamos, geared motors, &c., are all well shown and briefly described.

The G.E. Co., Limited, have issued a new instrument list, which is Section M of their general catalogue. The "Stanley" ammeters and voltmeters of several types are shown, also the Stanley d'Arsonval moving coil, Cardew, Kelvin and other measuring instruments. The Aron electricity meters, Holmes cut-outs, Stanley Junior ditto, time switches, testing instruments, portable and automobile instruments, and a large variety of other apparatus of the kind is detailed and illustrated.

Messrs. Francis & Spilsbury, of 20, Bucklersbury, E.C., have been appointed sole agents in the United Kingdom for the sale of Messrs. Mohr & Federhaff's manufactures, which include steam, electrical, and hand cranes, lifts, weighing machines, blowers, &c. The firm have sent to us a small booklet showing some of their manufactures, and also a set of photos, illustrating various cranes (electrical and steam) that they have supplied to different parts of the world. Messrs. Mohr & Federhaff have large works at Mannheim, Germany.

The Improved Electric Glow Lamp Company has issued an illustrated circular in which the Sterling direct current motors are described.

A list brought out by the Waltham Art Metal and Engineering Company shows in colours some of their artistic switches, also the showrooms at Buckingham Gate.

A list of electric safety lamps for miners is being circulated by the Sussmann E M.L. Company, Limited, also a reprint of a paper recently read by Mr. W. O. Wood on the Sussmann lamps, with which he has had practical experience in the Murton collieries, showing the safety and lighting efficiency of the lamps.

**Electricity on H.M.S. "Ophir."**—Before this vessel started on her historical voyage she was fitted with a large number of electric fans supplied by the General Electric Company (1900), Limited, who also furnished a large quantity of silver-plated pendants, standards and brackets for the State rooms; also electric irons, curling iron heaters, ship radiators, "Apollo" radiators, and all manner of other electrical stores; and about 7,000 "Robertson" lamps varying from 5 to 32 C.P.

**Fire Prevention.**—At the Berlin International Fire Congress this week the British Fire Prevention Committee is represented by a deputation comprising Mr. Edwin O. Sachs (chairman), Mr. Max Clarke, Mr. F. R. Farrow, Mr. F. Hammond (district surveyor, Hampstead), and Mr. Ellis Marsland (district surveyor, Camberwell). The deputation will be taking the opportunity to examine the general arrangements as to the working of the Building Law at Berlin, as well as the influence of the new theatre, factory and workshop regulations upon modern structures in that capital; and they will, on their return journey, visit the city of Hamburg, with a view to studying the general fire protective arrangements of the port and the more recent forms of warehouse construction which have been adopted in that city. On Thursday the deputation was to attend the opening of the Congress, held in the new Houses of Parliament. Of the four opening addresses, one was by Mr. Edwin O. Sachs, on the organisation of the Committee and its investigations in fire-resisting materials. The afternoon was to be occupied with visits to electrical factories. The professional part of their visit will terminate on Monday night; and the results of the observations made, as embodied in a report, should prove highly instructive reading.

The attention of the British Fire Prevention Committee having been called to the fact that the curious lack of enterprise on the part of the English fireproofing and fire appliance trade has resulted in this country being scarcely represented at the Berlin International Fire Exhibition, steps have now been taken to see that Great Britain is at least represented by some scientific exhibits. A large stand has, in fact, now been retained by the Committee to show photographs, plans, &c., of such materials and systems of construction as have been before the Committee for investigation, and a number of models are also being sent to Berlin. Further, some large plans and drawings of London fires are being shown, together with a very interesting collection of old insurance plates. Although the British Fire Prevention Committee has from patriotic motives tried to step into the breach at short notice with exhibits arranged from a scientific point of view, the lack of enterprise on the part of the trades concerned is highly regrettable, as the natural result can only be that much of the business to which Great Britain might well lay claim must again drift into the hands of the more energetic foreign competitors, who have taken the pains to show what they can do in meeting the requirements of fire protection. An Exhibition of this description has particular influence on visitors from the Colonies, and from countries such as Russia, Turkey, and the South American Republics, and if individual firms do not see their way to participate in exhibitions, the petty jealousies and rivalries should at least be so far overcome as to allow of an economical "collective" exhibit, so that the credit of the industries is upheld and a loss of trade prestige avoided. The remarks of the Paris Exhibition Commissioners in respect to the lack of initiative in foreign trade exhibitors can only too truly be repeated regarding this unfortunate case of industrial apathy at Berlin.

**For Sale.**—Our business pages contain particulars of engineering and electrical plant and apparatus to be offered for sale by auction by Messrs. P. Huddleston & Co., at the works of the International Explosive Company, Benfleet, on June 20th. Details are also given of a large quantity of electrical plant and machinery which will be offered for sale by Messrs. Wheatley Kirk, Price & Co. at the Broadheath Engineering Works of the Edison and Swan Company at an early date. Messrs. H. Steele & Son will sell certain electrical and chemical plant of the Phœnix Process Trust at Milton on June 18th, and Messrs. Wheatley Kirk will offer a large quantity of engineering plant for sale at Leeds on June 12th and 13th.

**Glasgow Exhibition.**—In our issue of May 24th, we stated that Messrs. A. and P. Steven are showing electric and other driven pumps. This, however, was a slip of the pen, as Messrs. Steven's exhibit consists of an electric passenger elevator, electric goods hoist, hydraulic passenger elevator and two belt-driven hoists.

**Imperial Theatre.**—This theatre is lighted entirely by electricity. The chief source of light in the auditorium is from lamps fixed behind sheets of amber glass in the ceiling, producing an effect of warm sunshine, and by secret lighting from long electric battens behind the cornices, electric torches are fixed round the tier fronts, and hanging lights of classic design are suspended from the marble walls. The whole of the electric lighting, both for the stage and front of house, as well as the wrought-iron and glass ceiling, arc lamps, fireproof curtain, &c., was carried out by Messrs. Vaughan and Brown, Limited, under the supervision of Mr. G. C. Vaughan, A.M.I.E.E.

**Larceny.**—At Clerkenwell, on May 4th, before Mr. McConnell, K.C., and other justices, George John Gibson was indicted for obtaining 30s. from the manager of the Westminster Supply Corporation by false pretences. Mr. Lawless appeared for the prosecution; Mr. E. Austen Farleigh for the prisoner. It appeared that on May 1st, one William East, a newsagent, who was driving in a wagon in Knightsbridge, was injured by the fall of a pole belonging to the Westminster Electric Supply Corporation. In the afternoon of the same day he requested the prisoner to write to the Corporation to inform them of the injuries, and to ascertain whether they were prepared to make any compensation. On the following day, East received a reply from the manager, who requested him to send a doctor's certificate as to the injuries. East showed this letter to the prisoner on the following Wednesday, and sent him again to the manager to ask for compensation. According to East's evidence, he did not authorise him to receive any sum from the manager. On Monday, May 6th, the prisoner received the sum of 30s. from the manager, and signed a receipt for the same on behalf of East in full satisfaction of his claim. He never produced this receipt to East. The manager, who was called as witness, stated that the sum of 30s. had been suggested by the prisoner. The carman who had been injured at the same time received only 30s. According to the prisoner, who was called to give evidence on his own behalf, he had been authorised by East to make the best terms he could with the Corporation. He also stated that he had offered the 30s. to East, but had not paid it owing to lack of moral courage. When he was arrested under warrant and charged with the offence, he said: "I expected that; I was a fool to have anything to do with it." The jury, after deliberating for about half an hour, found the prisoner guilty of larceny. He was sentenced to imprisonment in the second division for three calendar months.

**Tests of Turbo-Alternators.**—Messrs. C. A. Parsons and Co. send us a copy of a test conducted by Prof. Ewing, F.R.S., at the works of the Cambridge Electric Supply Company. The object of the test was to ascertain if any deterioration had taken place during the year's work, and its result was to confirm the claim of the makers that these machines do not deteriorate through wear. The figures which were obtained as to relation of the consumption of steam in pounds per hour to the output in kilowatts, give satisfactory evidence that the machine tested, working under the conditions of everyday use, retains its character as a highly efficient electrical generator. Prof. Ewing states that the efficiency is well maintained when the load is reduced even to one-fourth or less of its normal amount. We understand that Messrs. Parsons have recently taken an order for a turbine engine for delivery to Milan, capable of giving power to a 2,000-KW. dynamo (equal to about 3,000 I.H.P.) being built by Messrs. Brown, Boveri & Co., of Baden, Switzerland. The contracted time for delivery is 10 weeks from receipt of order.

**Trade Announcements.**—Mr. G. W. Clarke, "electrical consulting engineer and contractor," asks us to announce that he has recently opened a branch office and showrooms at 15, High Street, Grays. He has obtained a large number of orders for fitting up various shops, &c., shortly to be connected to the new supply mains. Mr. Clarke has obtained the contract for the supply of incandescent lamps for the coming year to the London and India Dock Company.

The head offices of Messrs. Crompton & Co., Limited, will be removed on June 10th to Salisbury House, London Wall, E.C.

Messrs. Julius Sax & Co., Limited, have removed their offices and stores from Camberwell to 51, Rupert Street, Coventry Street, W. They will thus have a West-End supply house, of which they have long recognised the necessity, and it will be equipped with a large stock of every requisite for electric bell and telephone work, also a stock of electric lighting materials of all kinds. The firm we understand to be the parent firm of Julius Sax & Co., established in 1855. Lists of high voltage fittings, electrical novelties, and so forth will be issued in a few days.

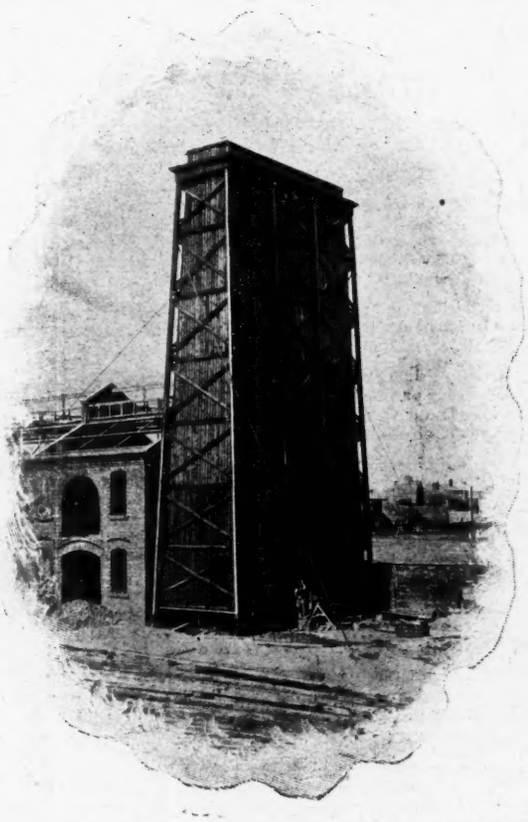
Messrs. John Menzies & Co. announce the entire transference of their business in Edinburgh from their old premises in Hanover Street to the new buildings in Rose Street, Edinburgh, which have been in course of construction for them during the last three years.

Messrs. Johnson & Phillips have opened a new London warehouse for the direct supply of their cables to the trade in the West End and other parts of London, at 37, King Street, Covent Garden, W.C. The same firm has also opened a new mechanical rubber department. This additional factory is fitted with the very latest machinery, driven electrically.

**West Bromwich.**—The Electric Lighting and Power Committee of the Town Council has entered into an arrangement with Messrs. Whittaker Brothers, wiring contractors, for the provision by them, at their own risk and charge, of a good stock of fittings in the electrical storeroom in the Market Hall for the convenience of customers.

**Westinghouse Integrating Wattmeters.**—The *London Gazette*, of May 21st, reports that the Board of Trade approve (May 17th, 1901) of the pattern and construction of the Shallenberger alternating current integrating wattmeter for the measurement of electrical energy when supplied on the constant potential alternating current system; and also that they further approve of the means provided for fixing these meters and for connecting them with service lines. The meter, specifications, and instructions were deposited at the Board of Trade by the British Westinghouse Electric and Manufacturing Company, Limited.

**Zschocke's Cooling Towers.**—We recently reproduced a photograph of the steam dynamos installed by Messrs. Scott and Mountain for traction at the South End station of the Birkenhead Corporation. The accompanying illustration shows the cooling tower installed by Messrs. Doherty & Donat, of Manchester, to cool the condensing water used in connection with the above engines. The main feature of this type of cooling tower is the method of distributing the water in thin films over a large surface by means of successive layers of wood battens; these are slightly inclined, so as to catch the falling drops of water, and their lower edges are serrated so as to form "dripping noses," from which the water drips



on to the next layer of battens. The cooler shown is of the closed or chimney type, giving a strong upward draught without fans; open coolers, with louvers at the sides, are also made. The average of readings taken at Birkenhead over 17 consecutive days, which are before us, shows that a vacuum of 26·9 in. of mercury was maintained, while the circulating water leaving the surface condenser at 95·6° F. was cooled down to 66·6° F. in the cooling tower. We are informed that 35 electricity works have been equipped with these coolers, and that over 600,000 I.H.P. in all have been supplied.

## ELECTRIC LIGHT AND POWER NOTES.

**Barnbougle Castle.**—Lord Rosebery is having an installation put in at Barnbougle Castle. The generating plant consists of a 20-B.H.P. "Hornsby-Akroyd" oil engine, a "Parker" dynamo of 100 amperes, 160 volts, at 770 revolutions per minute. There are also 60 cells of the Tudor type. The number of lights throughout will be about 200. Messrs. Anderson & Munro, Edinburgh, are the contractors.

**Birkenhead.**—The Electricity Committee have decided to recommend that the salary of Mr. Wm. Bates, city electrical engineer, be increased from £300 to £500, as from the first of the present year. The Committee have also resolved that application be made to the B.O.T. for a provisional order authorising the Corporation to supply electrical energy for public and private purposes within the districts of Higher and Lower Bebington and the district of Prenton.

Application is about to be made by the Electricity Committee for permission to borrow £40,000 for the following purposes in connection with the electric lighting service of the town:—For costs, charges, and expenses incurred in excess of amounts already sanctioned, £2,430; for providing additional generating plant at Bentinck Street works, £11,270; for generating plant to supply the south end of the borough, £5,000; for feeder and distribution mains for the Rock Ferry district, £8,000; for distributing mains in other parts of the borough, £7,500; for service mains and connections, terminal boxes, &c., £3,000; for arc lamp mains, lamp pillars, lamps, and switch pillars, £2,000.

**Blackburn.**—The sixth annual report on the working of the electricity department of the Blackburn Corporation, just issued by Mr. A. S. Giles, the electrical engineer, shows that the receipts for the year were £14,465 3s. 5d., as against £11,843 10s. in the previous twelve months. The expenditure was £9,383 1s. 10d. against £7,135 0s. 2d., and the gross profit £5,082 1s. 7d. After paying interest on capital and sinking fund, there remains a net profit balance of £273 7s. 8d. as against £19 1s. last year. The cost of generating in the works has been reduced from 1·65d. per unit to 1·32d., and the total cost, including management and distribution to consumers, from 2·07d. to 1·78d. per unit. The total output from the works for the year was 1,159,861 Board of Trade units sold. Mr. Giles does not advise any reduction in the tariff of charges, having regard to the high price of coal, but counsels a revision of the present rents for meters.

**Bridlington.**—At the monthly meeting of the T.C., held on the 29th ult., the Parliamentary and General Purposes Committee advised the Council that it was not an opportune time to carry out the Electric Lighting Order. The matter was raised in committee in consequence of a letter from the National Electric Traction Company, relating to the proposed agreement with the Flamborough and Bridlington Light Railway Company, and an extension of two years was recommended.

**Canary Islands.**—The British Consul in his report on the trade during 1900, remarks that "owing to the more general use of the electric light, the consumption of petroleum in these islands is becoming less each year."

**Chorley.**—The L.G.B. has sanctioned a £21,300 loan for electric lighting purposes, and £7,646 for a refuse destructor. The Council has arranged to interview the Lancashire Electric Power Company, and obtain terms for supply of electricity in bulk.

**Cirencester.**—At a meeting of the U.D.C. held on the 30th ult. the Lighting Committee presented a report on the question of supplying the town with electric light. After reviewing the subject, the Committee said they were of opinion that it was desirable to establish electric lighting, and they recommended that a provisional order be applied for.

**Colchester.**—Notice has been given that the Borough Council will apply to the Board of Trade for permission to alter the standard pressure from 210 volts to 420 volts across the outer wires and from 105 to 210 volts across the consumers' terminals.

**Dover.**—The annual staff dinner of the Dover Electricity Supply Company was held on May 30th under the presidency of Sir William Crundall.

**Eccles.**—The borough electrical engineer has submitted to the Public Lighting and Electricity Supply Committee an estimate of the capital cost of the erection of plant for the supply of electric energy for tramway and lighting purposes, and it was resolved to authorise the Committee to proceed with the preparation of the necessary plans and estimates for submission to the L.G.B. with an application for their sanction to borrow £21,000 for electric light extensions. The Committee further resolved that the Salford Corporation be informed that the Council is prepared to supply the electric energy for the working of the tramways in the borough at 2d. per unit.

**Epsom.**—The U.D.C. has decided to engage a resident electrical engineer to supervise the erection of the Council's generating station, &c., at a salary of £3 weekly.

**Glasgow.**—Mr. Chamen, the engineer, in a supplementary report to the Council on electricity charges, states that "the one hour and under" consumers have cost about £164,780 in capital expenditure and produce a revenue of £6,208, or 3·7 per cent. Consumers over one hour, excluding theatres, churches, and power, have cost about £478,578 in capital expenditure and produce a revenue of £46,154, or 9·6 per cent. The estimate for next year being 9,000,000 units sold, would produce £104,000 and expenditure £98,000. He points out that this quantity, compared with some 6,000,000 units last year, will require to be sold to prevent a deficit, as the Corporation stand committed to further capital expenditure which will increase the interest by some £10,000.

The treasurer of the Electricity Committee reports that the receipts for the current year from June 1st, 1900, to May 1st, 1901, are £59,760, compared with £47,125 for the corresponding period last year. It is expected that this increase of £12,635 may yet amount to some £15,000, as the department have had to supply over 2,000 units every evening during May for the lighting of the Exhibition.

**Goole.**—The Board of Trade have granted a provisional order to the U.D.C. for the supply of electricity. The maximum price to be charged to consumers is fixed at 11s. 8d. per quarter for any amount up to 20 units, and for each unit over 20 an additional 7d.

**Grays.**—At the Urban District Council meeting on May 23rd, Mr. Preece, the Council's electrical adviser, wrote recommending Mr. E. T. Long, formerly in their office, as resident engineer at the Grays works. After discussion it was ultimately decided to advertise for a resident engineer.

**Hoylake and West Kirby.**—The municipal electricity works are to be publicly opened to-morrow (Saturday).

**India.**—With reference to the statement which appeared in our issue for April 26th, regarding the lighting of the Boer prisoners' huts at Ahmednagar, Messrs. Turner, Hoare & Co., engineers and contractors, of Bombay, ask us to state that the contract for the whole of this installation has been given to them.

**Kimberley.**—The Borough Council lately discussed the electrician's report, having reference to electric lighting after 1 a.m., and amalgamation of the two systems. It was resolved to refer the matters to the lighting committee for consideration and report.

**Lancaster.**—At the meeting of the T.C. on May 29th, it was reported that the profit on the electric lighting department during the past year was £427 9s. 3d., compared with £1,000 from the gas. The decision of the committee not to sell the powers to construct the electric tramways in the borough was confirmed.

**Leigh.**—The Corporation are making considerable extensions of their electricity mains.

**Liverpool.**—Application has been made to the L.G.B. by the Corporation for sanction to borrow £300,000 for electric lighting purposes. The L.G.B. inquiry regarding the loan was opened on Wednesday.

**London.**—SOUTHWARK.—The City of London Electric Lighting Company, Limited, says the *City Press*, intend applying to the B. of T. for a provisional order empowering them to supply electric energy for all purposes in the borough.

GREENWICH, S.E.—The Borough Council has disapproved of a provisional order being granted to the City of London Electric Lighting Company, Limited, to supply electric energy for all purposes in the borough.

**Manchester.**—The Electricity Committee have appointed Mr. W. E. Warrilow as junior mains assistant at a salary of £120 per annum; Mr. E. A. Uttley as shift engineer at Dickinson Street station at a salary of £150 per annum; and Mr. E. Bolton to the position of assistant in charge of sub-stations at the salary of £200 per annum.

**Paraguay.**—In his trade report for the year 1900, Mr. Consul Gosling says: "A concession has been given to a North American company for lighting the town of Asuncion by electricity."

**Perth.**—The municipal electricity supply works were inaugurated on Saturday last. The scheme, which is now completed, has been carried out at a cost of £30,000, and is a much more extensive one than was at first proposed. The undertaking has been carried out under the guidance of Mr. Hawtayne. The works are situated on the Harbour Road adjoining the river Tay. The buildings have been designed with a view to facilitate the carrying out of future extensions for lighting and traction, the plant erected at present being for lighting purposes alone. The shaft is so situated and constructed that it can be utilised when required as the chimney of a refuse destructor for destroying the town's refuse. There are three water-tube boilers, each capable of producing under normal conditions 6,000 lbs. of dry steam per hour at 200 lbs. pressure. These boilers are supplied with fittings of Messrs. Hopkinson's manufacture, and are provided with all necessary safety, isolating and other valves. There are two feed pumps, one being a steam pump and the other being a motor-driven pump, which can be worked from the storage battery if necessary. In the main flue is a Green's economiser. An independent surface-condensing plant is provided, cooling water being obtained from the river Tay. There is a 2,000-gallon feed tank. The steam dynamos were supplied by Messrs. Bruce Peebles & Co., and they consist of dynamos of their own make, direct-coupled to high-speed engines by Messrs. Willans and Robinson. One of these steam dynamos is capable of developing 75 KW. at 460 revolutions per minute; the other two are for 200 KW. at 350 revolutions. The dynamos have been designed for either traction or lighting purposes. A set of four motor balancing motor-generators and boosters have been installed, also of Messrs. Bruce Peebles & Co.'s make. The switchboard, supplied by Messrs. Lowden Bros. & Co., is built up in panels of enamelled slate, and provided with all the latest improvements. The storage battery (E.P.S.) has a capacity of 600 ampere-hours when discharged at the rate of 200 amperes for three hours. The feeders, distributors, &c., have been supplied by Callender's Cable Company. The feeder cables are armoured concentric cables laid direct in the ground. The distributing cables are laid in a wooden trough filled in with bitumen. The service cables are armoured and laid direct in the ground. The original

contract was for 45 arc lamps, but this has since been increased, and the number now provided is 67. Each of these is of about 1,000 C.P., and each post is provided with two incandescent lamps. Cross arms will be provided on the columns in South Street to support the trolley wires, and the necessary switching gear is contained in the bases. These columns were specially designed by Mr. Hawtayne, and supplied by Messrs. Lucy & Co., Limited. About 84 gas columns are being adapted for incandescent electric lighting. A good deal of ceremony accompanied the formal opening, which was attended by a large and representative company. The station was formally opened by Lord Provost Macgregor, who was presented with a golden key by Mr. Hawtayne. The guests then gathered round the engines to witness a further ceremony. The first engine was turned on by the Lord Provost amid loud cheers, and the second by Sir Robert Prullan, who afterwards called for three cheers for the undertaking. On the call of the Lord Provost, Mrs. Wright, the wife of the convener of the committee, then switched on the light, and was afterwards presented with a gold bracelet by Mr. Callender, of the Callender Cable and Construction Co., Limited, on behalf of the contractors as a souvenir of the occasion. Councillor Slieve switched on the light to the street lamps.

At a cake and wine banquet which followed, a number of toasts were proposed and responded to, Mr. Hawtayne replying on behalf of the engineers.

Mr. Callender replied on behalf of the contractors.

On behalf of the Town Council and a few friends, the Lord Provost presented the Convener of the Electric Lighting Committee with a silver salver and a purse of sovereigns, and in doing so referred to the great work done by him.

**Rosario.**—In his annual trade report for 1900, Mr. Consul H. M. Mallet says that among the things that offer a fairly safe investment for capital is "electricity, more especially in the way of lighting and tramways."

**St. Helens.**—The town clerk has been instructed to apply to the L.G.B. for sanction to borrow £16,500 for additional electric lighting plant.

**Spain.**—A central electric lighting station is being established in the town of Redondela (Pontevedra). The water power of the River Verdugo is being utilised.

**Sunderland.**—At the meeting of the Lighting Committee on Friday last, Mr. J. F. C. Snell, the electrical engineer, submitted his annual report, from which it appeared that there was a net profit on the year of about £1,200. This is more than was anticipated.

**West Ham.**—As a result of an exhaustive inquiry into the repeated breakdowns of the electric lighting plant of West Ham, the local Lighting and Tramways Committee of the Town Council report that they are forced to the conclusion that the damage to the plant was maliciously caused, and that they have given instructions for all that is possible to be done to discover the culprit. Among specific cases cited by the contractors are the following: Hemp jammed into the oilways, wilful shutting down of stop-valve, forcing of a couple of bolts into the gear box, purloining of tools and appliances.

**Wimbledon.**—The capital outlay of the electricity department for the 12 months ended in March next, is estimated at £7,500, and the L.G.B. is to be applied to *re* loan.

## ELECTRIC TRACTION NOTES.

**Berlin.**—The Berlin municipal authorities have granted 20,000 marks for the preparation of a plan for an underground railway, which is to run from north to south of Berlin, following the line of the Friedrich Strasse.

**Birkenhead.**—The Tramways Committee have decided to apply for powers to borrow £13,000 to defray the cost of 15 new cars, and £7,500 as the cost of extending the electrical generating plant. A previous resolution to apply for £21,000 for doubling certain tracks has been rescinded. Instead of this the Corporation will ask for £11,000 to double tracks in Park Road North, New Chester Road from Green Lane to St. Paul's Road, Laird Street and part of Park Road South, and Prenton Road West.

**East Ham.**—The electric tram system owned by the District Council is practically completed, and the trams are expected to be running in the course of a few days.

**Germany.**—A concession to construct an electric tramway between Erbenstein and Wiesbaden and work the same during a period of 45 years, has been secured by the South German Railway Company.

**Glasgow.**—The Tramway Committee on Wednesday last week had before them reports by Mr. Young, the tramways general manager, regarding the condition of the Allis (American) engines, and also the frequency with which accidents have occurred in the city since the introduction of the electric car service. Consideration of the whole matter was delayed until Friday last, when a special meeting of the committee was held. Mr. Parshall was present, and made a verbal report regarding the operations at Pinkston works. The manager's reports were adopted generally by the committee, and were to be submitted to the Corporation at yesterday's meeting. In his report on the progress of Pinkston Power Station, Mr. Young said:—"I reported a fortnight ago that further public sales of horses had, meantime, been postponed, on account of neither of the Allis engines being able to run for any length of time without heating. Since then we have experienced two weeks of disappointment in this same connection, and, as yet, we have not had the use of either of the Allis engines for operating cars. The defects are chiefly in connection with the oiling arrangements, and none of them seems to be at all of a serious nature. Most of them could, however, have been prevented by a little more care and foresight. There is no truth in the reports that the foundations or sole plates of these engines had given way. The chief expert of the Allis Company arrived on the 16th inst., and has since taken the overhauling of the engines in hand, with the result that No. 1 engine was started and run on quarter load (artificial) yesterday afternoon. She was shut down overnight for some further adjustments. This morning she is running on full-water load, and the expert in charge believes she will be fit for operating cars after running 24 hours at full speed on full load. This points to getting the use of this engine not later than Friday. The expert also believes that engine No. 2, which they are overhauling on the same lines as they have done No. 1, will be ready for operating cars on Monday next. On April 27th—the Saturday following the formal opening—we started to operate a few cars by the Stewart auxiliary engines, in the full expectation that the first Allis engine would be available for operating within a very few days. In point of fact, however, it only operated cars for a short time on Thursday and Friday, May 9th and 10th, but had to be shut down on the evening of the 10th on account of the oil not getting proper access to the bearings, and we have had no use of it since. Messrs. D. Stewart & Co. have, at my special request, kept their auxiliary engines working since April 27th, and, by assistance from Springburn power station, we have thus been able, although with difficulty, to maintain a service of electric cars on the routes converging on the Exhibition. For some days the Stewart engines operated 80 cars, but we had to reduce the number to 75, and afterwards to 65—the number now running—for fear of anything like a breakdown. In fact, we have been operating the traffic during these past few weeks with a mixed-up service of horse and electric cars, under very great disadvantages and difficulties, on account of disappointments in connection with the power supply. What we are now pressing for is the use of the first Allis engine to operate cars on half load to begin—say, 100 cars—and we should hold the Stewart engines as a reserve, in the event of stopping from heating or any other cause, for a few days until the second Allis engine is in complete working order. Then one Allis engine can operate 200 cars or more, the other standing by as a reserve. The first Musgrave engine is now promised in June—three weeks hence. To accomplish this, however, a great change will require to take place in the rate of progress. So soon as it is ready we can work over 400 cars with two engines, holding the third in reserve. This will practically operate the whole of the present system. Messrs. Musgrave cannot condescend on a date for the completion of their second engine. Meantime, so soon as the two Allis engines are ready to operate, the Stewart engines will be overhauled and made to the satisfaction of the consulting engineer, seeing there has been no opportunity hitherto of adjusting the governors and otherwise preparing them for the required tests. The cranes supplied by the Clayton Company have been unsatisfactory from the first, and still give trouble. Only such repairs as are necessary to keep them working have been made, as the erecting engineers cannot, of course, proceed without them. The Clay Cross Company, who have the contract for economisers, have made most unsatisfactory progress. Their first economiser is not yet complete, and I cannot say when we may have the use of it." Mr. Young adds the following postscript to his report:—"I am glad to say that the first Allis engine ran continuously on full water load yesterday. This morning the sub-station cables have been changed back for the high tension current, and, as a matter of fact, the cars are now being operated by the first Allis engine. We are assured that the second Allis engine will also be ready for car load on Wednesday first, so that next week should see us over the worst of initial difficulties."

The report on the recent car accidents shows that 40 per cent. of these have been due to persons joining or leaving the cars while in motion, and 40 per cent. due to collisions. Mr. Young urges the necessity of the public looking after themselves and their children. The motormen have been well trained, and are stated to understand their business thoroughly, as well as being under strict discipline. As usual, there has been a good deal of exaggeration about the reports of accidents in connection with the Glasgow tramways.

**Halifax.**—Some time back the electrical engineer, Mr. Street, accompanied by Mr. J. H. Whitley, M.P., went on a tour to America to gather information on electrical equipment for tramway purposes, and at present the borough engineer, Mr. Lord, is on a visit there, seeing to the carrying out of an order given by the Corporation for £15,000 of rails to an American firm.

**Light Railways.**—The *London Gazette*, of May 31st, contains notices of the following light railway orders:—Preston and Horwich (Auxiliary and Light Railways and Tramways Company, Limited); Preston and Lytham (promoters, E. Bois, G. Hunter and C. Osborne); Tottenham, Walthamstow and Epping Forest (The Metropolitan Tramways and Omnibus Company, Limited); London United Tramways, Limited (extensions); Canterbury, Herne Bay and Whitstable (O. W. Bowen and W. J. Kershaw); Rotherham and Laughton; Wakefield and District (extensions), promoters, Messrs.

J. Fell, J. J. Gittings, E. Horton, W. J. Kershaw and others. The Bridlington and North Frodingham (extension of time) and the Lizard (extension of time) notices are filed in the *Gazette* for June 4th.

**Llandudno.**—Sir George Newnes, M.P., is to open the new Great Orme's Head electric tramway at Llandudno at the beginning of August.

**Musselburgh.**—At a special meeting of the T.C. for the purpose of confirming a resolution to serve on the National Electric Traction Company, Limited, a notice requiring them to transfer to the Corporation their powers for the construction of tramways, so far as these are within the jurisdiction of Edinburgh Corporation.

**Portable and Light Railways.**—The light railway is always with us—on paper—but it is rarely seen. Mr. Walwyn White discusses the subject in the *Engineering Times*, and points out that nothing has really been done in the way of light railways. Lines have, it is true, been built under the Light Railways Act, but they have been of 4 ft. 8½ in. gauge, with heavy rails, and have cost £7,000 and £8,000 per mile, and have usually been the bantling of some great railway company. Very little good has accrued to the agricultural interests from light railways, yet this country imports 30 millions sterling of farm produce that could as well be produced at home. The trouble is that our engineers are so hide-bound that they cannot build a light railway proper, such as will pay in a poor district. A light railway can be built for £2,500 per mile, and would yield handsome dividends on a traffic of £7 to £8 per mile per week—a revenue that would starve a so-called light line as usually built. Yet engineers persist in designing lines to take fifty-fold this traffic. A suitable light gauge is 2 ft. 6 in. This will reduce the cost of works, enable sharp curves to be worked as sharp as 200 yards radius, and so enable the line to run round hills and obstacles that a standard line would need to run through. Mr. White proposes to abolish caretakers at crossings, and substitute self-acting gates, and on this point it should be remembered that a really light railway cheaply constructed does not require to be worked at high speeds, and must not be expected to afford them. In any case, it will afford a speed superior to the farmer's wagon, and it will serve its intended purpose. A 30-in. gauge with 30-lb. rails will carry loads of eight tons on two axles. Such a line will pay on the traffic of £7 per mile per week, and yet it would carry as much as £50 if required. The author speaks of speeds on such a line of 25 miles per hour with gradients of 1 in 40 or 50, but he would prefer to limit grades to 1 in 80, and though curves of 50 yards could be taken safely, he would prefer 250 ft. as a minimum radius. There should be no stations, signals, interlocking gear, continuous brakes, &c. Wayleaves should be optionally by annual instalments. Sleepers should be metal. Land should be acquired at agricultural value. Advantages of narrow gauge are:—(*a*) The Railway Clearing House when dividing profits allows 9d. per ton to the light line—this more than covers cost; (*b*) working expenses are less; (*c*) the rolling stock cannot get astray; (*d*) main line engines cannot trespass on the light line and damage it; (*e*) rolling stock can be light. The Southwold line has working expenses only £4 5s. per mile per week. It has a 3 ft. gauge. The break of gauge is not a very serious matter after all. On the Festiniog Railway it only cost ¾d. per ton for minerals to transfer to broad gauge, ½d. for general goods, and 6d. for slates, which are moved by hand. The box system is suggested for fish and farm produce, boxes holding about 2 cubic yards each, so made that six boxes fit inside on broad-gauge wagon. Particulars are given of rolling stock, but none of it is electrical. We think that there ought to be an opening for light lines electrically worked when current can be purchased from some electric station. There must be many possible lines that could thus purchase their motive power. It remains for electricians to afford a safe, cheap construction for overhead equipment. We say overhead because the third rail hardly seems to us admissible on a country line, probably unfenced. In Belgium it appears that capital is raised for light railways in the proportion of 27 per cent. by the State, 28 per cent. by the province, and 40·9 by the communes, only 4·1 per cent. being subscribed by the private individual. Mr. White suggests a fourth by the local main line to which the light line acts as a feeder, a fourth by the landowners, a fourth by the County Council, and a fourth by the public, but the management should be with the Light Railway Company, and should not be allowed to revert to the big railway as is often the case. That some further means of communication are required is clear. Our railways never have grasped the true significance of business, perhaps because few of them have real practical directors, and their sole aim appears to be to encourage the import of foreign produce and the export of coal, so that British coal is cheaper abroad than at home, and foreign produce is carried past our farms from France for less than British product is carried from Kent to London. It seems hopeless to expect sound views or fair treatment at the hands of our railways which contrive neither to manage goods traffic well nor to give satisfaction in their suburban passenger traffic.

**Rossendale.**—A scheme will shortly be laid before the Light Railways Commissioners for the construction of an electric tramways system to connect Rossendale with the Bolton and Darwen tramways through the Ramsbottom and Tottington districts. It is proposed to carry both passengers and goods.

**South Shields.**—This month the British Electric Traction Company will promote a Bill in Parliament for a system of light railways connecting South Shields with the adjacent villages of Whitburn, Fulwell, Harton, &c. They would be a great boon to the people in the vicinity, for means of communication are indeed bad. The South Shields Corporations has decided to oppose the company if the company seek powers to come into that borough.

**St. Helens.**—The town clerk has been instructed to apply to the B. of T. for permission to borrow £10,000 for additional plant for electric traction purposes.

**Sunderland.**—The Electric Tramway Committee are so satisfied with the results achieved in connection with the system, and so sanguine as to its future, that a special meeting of the Committee is to be held at an early date to consider the question of further extensions. Work is already in hand in regard to the last two extensions decided on; the Villette Road portion is practically completed, and it is expected that the lines to Grangetown will be done in about two months. This will finish the contracts that Messrs. Dick, Kerr & Co. have in hand. As showing to some extent the patronage the trams receive, it may be mentioned that on Whit Monday they carried 100,000 passengers, on the Tuesday about 60,000, and on the Wednesday 50,000. On the old system the record was about 30,000. Further, the takings for the fortnight before Whit-week were £1,900, an increase of £1,300 on last year, and the receipts for the three days of Whit-week we have mentioned were £1,400. It is probable that the next extension will be eastwards, towards the Docks.

**Wigan.**—An inspection of the new electric tramway line between Wigan and Boar's Head has been made by Major Druitt, R.E., L.G.B. inspector. It is expected that the cars will commence running in a day or two.

**The Underground and Electric Traction.**—A meeting of shareholders of the District Railway Company was to be held yesterday to consider certain agreements which it is proposed to make in connection with the scheme for converting the company's system from steam into electric traction. A new company has been formed to carry out the work, called the Metropolitan District Electric Traction Company, Limited. This company proposes to lay down the new permanent way, provide the new rolling stock, and erect a generating station. A site for the station has been selected at Lots Road, Chelsea, and it is understood that when complete the premises will be leased by the Traction Company to the railway company at a rent based on a percentage of the expenditure. "The particular system of electric traction to be adopted is still undecided."

**Wednesbury.**—At Monday's T.C. meeting the Mayor moved a resolution to the effect that that portion of the South Staffordshire tramways in the borough which the Corporation were now entitled to purchase, be valued by an engineer or other fit person nominated as referee by the Board of Trade. The question, the Mayor pointed out, had been before the Council for some time, and they found they would be able to purchase a portion of the tramway route in 1905. The company would only sell as each lease expired, and there was no alternative but for the Council to ask for the appointment of a referee. The resolution was carried.

## TELEGRAPH AND TELEPHONE NOTES.

**Cape—Australia Cable.**—The Eastern Telegraph Company notifies that the first section, between Durban and Mauritius, of their Cape to Australia cable, has been successfully laid.

**London To Brussels Telephone.**—The *Daily Chronicle* says that the London—Brussels telephone is now completed, and trials are at present in progress which will continue for the next month or six weeks. It is expected that the service will be ready for the public about the middle of July.

**The Mercadier System.**—We understand that the experiments with this system will shortly be resumed. The first experiments in England were conducted on a copper wire running from London to Glasgow, and were under the surveillance of Post Office Engineers. The sending operators were in the G.P.O. experimental room. The system is a syntonic one. Twelve Morse keys are used for sending, and vibrating reeds communicate different vibration to the currents before they enter the line wire. At the remote station the currents are received in a microphonic receiver and thence discharged into 12 receivers. The receivers consist eventually of telephone receivers with tuned diaphragms which respond to vibrations of a certain frequency and to no others. They thus select their own currents and respond only to the marks sent out by the key to which they are attached. The experiments in England were not under the supervision of the inventor, and they terminated eventually in consequence of certain faults occurring in the apparatus which it was impossible to remedy without the personal attention of M. Mercadier. As soon as the apparatus is returned from Paris the trials will be resumed. Interruptions were also caused by the faulty working of the other Glasgow wires necessitating the appropriation of the experimental wire for the public work. Under the circumstances a conspicuous success was hardly to be expected.

*(Continued on page 981)*

## ELECTRIC LIGHTING AND TRACTION AT ILFORD.

The growth of our great cities is rapidly increasing the importance of all suburban areas, and these are stretching their borders farther and farther out until they, with other outer areas, are becoming one great whole with the parent city whose industry and life, and the multiplication thereof, have made them a necessity. Districts which a few years ago were regarded as places of no importance, as being too far away from the hives of industry, have been brought near by the betterment of railway facilities and the erection of small properties letting at comparatively low rentals. An eight-mile run from the city of London is not a great distance, and full advantage is being taken of the cheap railway fares which workmen claim and secure as their special right. In this way railways are conferring a boon upon one class of the community, and are aiding in a degree in relieving the congestion of more central areas. But what the steam railways have accomplished in this matter is but small compared with what is expected from the operation of cheap and frequent electric trolley cars, when these are running out from the metropolis in a spider web fashion in all directions, as we trust they will be before many years have passed. For the better solution of the housing problem we are inclined to trust more to the construction of electric tramways and light railways than to the promises and measures of legislators, however sincere they may be in their endeavours to wipe out so terrible an evil as that of overcrowding. We would to goodness that this London County Council would push on a little faster with its tram projects. The unconscionable delays which have taken place during the past decade in discussing what system to employ in London have been dearly paid for. It would have paid London to have permitted electric trolley lines five or six years ago, even if these did have to be scrapped after a time, for London would have been far better developed, and the economies of electrical working would have been very considerable. The housing problem would have been far nearer a solution than it is now. But it is hardly of use wasting time in vain regrets to-day. So far as electric traction is concerned, perhaps the adoption of the conduit for London streets will prove to be the right thing, but the delays on that account have kept the whole of London back in other ways. The conduit has been decided upon, and the sooner it comes the better.

The question of cheap communication is of very pressing importance in connection with the development of such districts as Ilford, Essex. It may be that later on tramways owned by the local authorities will be working in intercommunication with the lines of the London County Council, so that the entire distance of 7½ or 8 miles from London can be covered by car, and perhaps there may also be a "tuppenny tube" system to increase the means of speedily reaching such localities.

These districts are developing themselves on up-to-date lines, as instanced in the case of Barnes, to which we referred last week. Ilford is another place of the same enterprising spirit; but in addition to electric lighting supply, which will be available for the thousands of new premises which are building, there will be an excellent trolley car service, which will be a remarkable help in the closing in of so straggling a district.

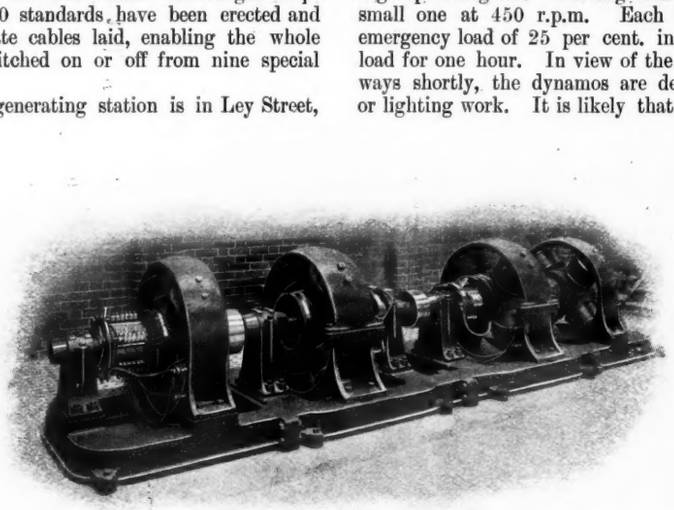
A View of High Road, Ilford.

The Urban District Council has for some time past been engaged upon a large combined electric lighting and traction scheme, for which Mr. W. C. C. Hawtayne has acted as consulting engineer. The lighting part of the undertaking, upon which some £60,000 have been expended, is now completed, its public inauguration having taken place on May 25th, when Mrs. Weeden, wife of the chairman of the Electric Lighting Committee, declared the works open, and switched on the light.

It will be some little time before the tramways are in operation, but in the High Road the central arc lamp pillars (steel), which are in position, also carry the trolley cross-arms, and a view of this thoroughfare as it now appears is given in the first of the photographs accompanying this article. The necessary switch gear for these columns is contained in the cast-iron bases. The pillars, it should be mentioned, were specially designed for the Council by the consulting engineer. Arc lamp columns are also in position in Cranbrook Road, these being of cast-iron, and the lamps of 1,500 c.p. In all cases the arc pillars are fitted with a

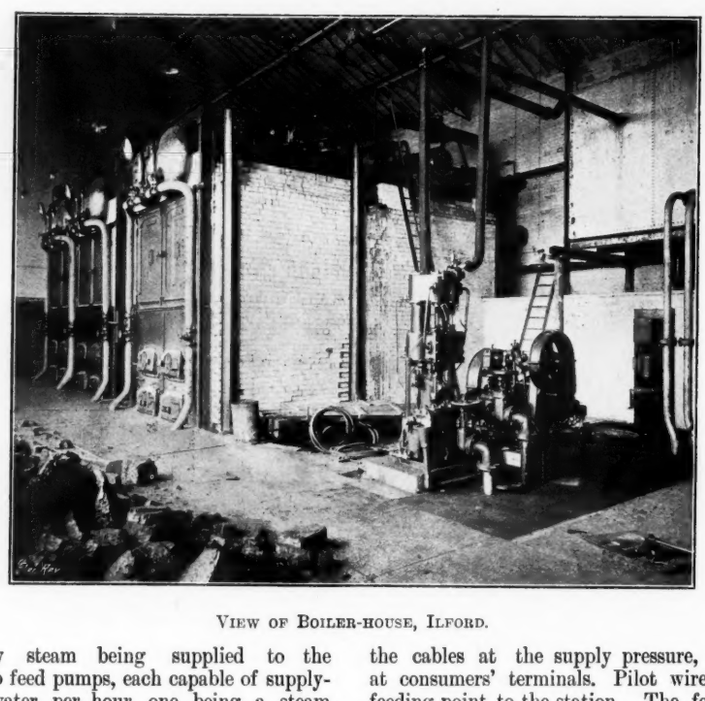
couple of incandescents for switching in at midnight. The remaining streets in the lighting area are being rapidly provided with new lamp columns equipped with incandescent electric lamps, and these will soon render the old gas lamps unnecessary. About 300 standards have been erected and 36,000 yards of separate cables laid, enabling the whole of the lamps to be switched on or off from nine special pillars.

The position of the generating station is in Ley Street, a little over a mile from the railway station and the central streets. A very large plot of land has been purchased by the Council in order to accommodate lighting station, car sheds, workshops, &c. The buildings were designed by Mr. H. Shaw, the surveyor to the Council, and are light and roomy. Ample space is left in the engine and boiler houses for additional machinery, and the west wall will be removed when still further extensions are required.



The Boosters at Ilford.

The engine house is faced with brown and white glazed bricks, and is built in bays, with brick piers supporting a gantry, on which runs a travelling crane; at one end of the room are the battery regulators. The steam dynamos are ranged along the north wall adjoining the boiler house, and on the south wall is a gallery, approached by stairs from the engine house floor, on which the switchboard is placed. The floors of the engine room and switchboard gallery are laid with pitch pine blocks on concrete bed.



View of Boiler-house, Ilford.

There are three Babcock & Wilcox water-tube boilers, each capable of easily producing, under normal conditions, 7,000 lbs. of dry steam per hour at 200 lbs. pressure. These boilers are supplied with fittings of Messrs. Hopkinson's manufacture, and are provided with all necessary safety, isolating, and other valves. Superheaters are provided with each boiler to ensure dry steam being supplied to the engines. There are two feed pumps, each capable of supplying 2,000 gallons of water per hour, one being a steam pump and the other a motor-driven pump, which can be worked from the storage battery if necessary. In the main flue leading to the chimney shaft a Green's economiser is provided for raising the temperature of the feed water by means of the waste gases escaping up the shaft. The steam pipes are of lap-welded mild steel with wrought-steel flanges, and the exhaust pipes are of cast-iron. A 2,000-gallon wrought-iron feed tank is also in use, and a well is now being sunk to provide the whole of the water required for the works.

There are two 200-kw. Byng-Hawkins dynamos and one 100-kw. ditto, supplied by the General Electric Company, Limited, each of these being direct coupled to Willans enclosed high-speed engines. The large sets run at 350 r.p.m., and the small one at 450 r.p.m. Each is capable of giving an emergency load of 25 per cent. in excess of the normal full load for one hour. In view of the running of electric tramways shortly, the dynamos are designed for either traction or lighting work. It is likely that additional sets of about 500 kw. will be installed when the tramway plant, for which specifications are being prepared by the consultant, is put down.

We show in one of our illustrations a set of four balancing motor-generators and boosters, which have also been furnished by the General Electric Company, Limited. Their object is to raise the pressure of the principal machines for charging the battery and for regulating pressure at all points on the supply mains. The battery is of the E.P.S. type, and has a capacity of 600 ampere-hours when discharged at the rate of 200 amperes for three hours. Our picture of the battery room will show something of its nature.

From our photograph of the switchboard it will be seen that this part of the work is of handsome appearance. It was designed by Messrs. Kelvin & James White, Limited, and is built up in panels of polished marble, and provided with all the makers' latest improvements in switches, cut-outs, and regulating gear, and also a complete set of instruments, by which the output of each machine and the load on all parts of the system is measured and recorded. The 15-ton overhead travelling crane erected in the engine room was made by the Southgate Engineering Company.

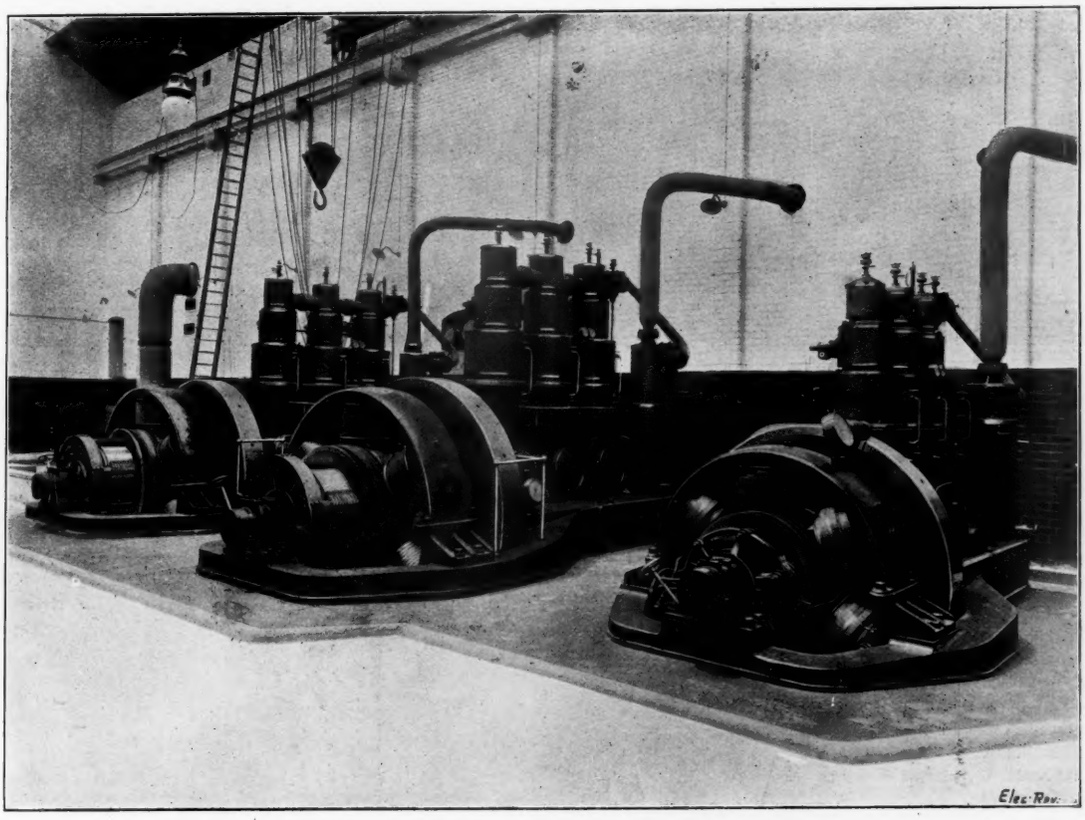
The feeder cables run from the generating station out to a number of different points, and at the distributing points it feeds the cables at the supply pressure, which is 230 volts at consumers' terminals. Pilot wires are laid from each feeding point to the station. The feeders, distributors, and service lines were all supplied by Messrs. W. T. Henley's Telegraph Works Company.

The feeder cables are armoured concentric cables laid direct in the ground; the distributing cables consist of three separate cables laid in a wooden trough filled in with bitumen. The service cables consist of two or three cables bound together, armoured, and laid direct in the ground. Considerable additions have been made to the mains first provided, and the work now completed or contemplated

includes approximately 17,800 yards of feeders, 17,800 yards of pilot wire, and 30,000 yards of distributors.

It is necessary in a district such as this, which consists largely of small residential and shop premises, to offer every inducement to the public to come on. The Council has accordingly entered into agreements with the Magnet Engineering company and others for the wiring of consumers' premises. Also with a view to bringing the matter prominently before the people, an electrical exhibition has been held at the Public Reading Room. Here they have been able to make themselves acquainted with a variety of electric lighting, heating, and other apparatus placed on view by several well-known manufacturers.

The arc lamps and posts for the street lighting were all supplied by Messrs. Veritys, Limited, the incandescent street lighting being done by the Improved Electric Glow Lamp Company, Limited.



Ilford Electricity Works.—G.E.C.-Willans Generators.

Mr. A. H. Shaw, A.M.I.E.E., is the resident electrical engineer.

The works are already supplying from 3,000 to 4,000 lamps, and as new buildings are erecting on every hand, and new roads opening up at a very rapid rate, there should be an excellent supply business at Ilford in the course of a year or two. The scattered nature of the district, and the increase of residents, are rendering the tramways an urgent necessity, and we have no doubt that when they are running they will be eagerly patronised.

## HOW TO PUSH FOREIGN BUSINESS.

Over and over again in the columns of the Electrical Review have we urged upon British manufacturers the necessity of taking more elaborate steps to procure engineering business in foreign parts. We have emphasised the opinion, so often expressed by those qualified to form a correct view, that tons of circulars will not do so much good as an ounce of personal and pushing effort. Catalogues and lists are often cast aside just because they are catalogues and lists, and should an occasion arise when they might, perhaps, be of some service, they are either forgotten or not at hand. Some manufacturers adopt the plan of advertising in the press published in and circulating in the countries which they regard as likely markets for their wares, and this may have something to commend it, but there is nothing to be compared with the organisation of a foreign mission scheme, with a capable man as your own personal missionary. We hear a good deal about foreign competition, and believe some of it, but we are inclined to think that cheapness of manufacture and many of these other things which are said to be our rivals' special weapons, have less to do with our defeat than have the push and energy which the foreigner employs against us.

We, together with others, have, on the strength of consular reports, persistently advocated the sending out of able men to foreign countries, and we had hoped that our efforts had been of some good. We think, however, the present is a very opportune moment for again raising the question of how many English electrical manufacturing firms are represented in the great and small foreign commercial markets by a man who is not only an engineer, but who combines, along with such necessary qualification, a real, thorough-going spirit of business enterprise? It is probable that those who have not previously given the subject that serious consideration which its importance merits might find it well worth their while to weigh it very carefully. No doubt they have on their staff a well-tried and go-ahead man who has a good acquaintance with their business in particular and the ways of the electrical trade in general, and who would be just the man for the purpose. We have seen instances of this kind of thing where the cost of the expedition has been paid for many times over by the business which has followed as the direct outcome of the effort.

American electrical manufacturers have during the past year or so been showing greater activity in seeking foreign orders than in looking for home contracts. The American technical press has fallen in line with the feelings of the trade, and latterly nearly every number of some of our trans-Atlantic

wrought-iron feed tank is also in use, and a well is now being sunk to provide the whole of the water required for the works. Considerable additions have been made to the mains first provided, and the work now completed or contemplated

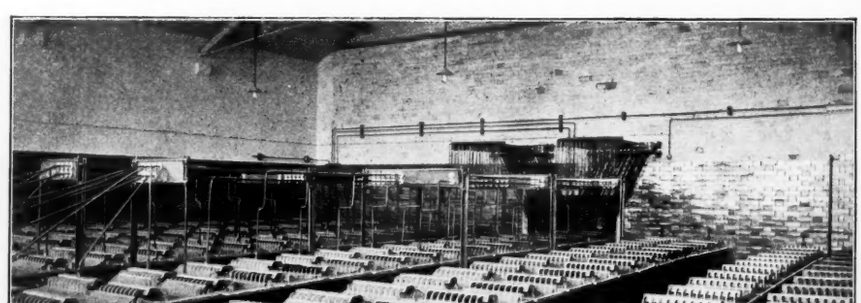


contemporaries has been either an international edition or an export trade issue. We might say much here as to whether the contents justify the title, but we will not, as that is beside the point—the fact itself is sufficient to show that foreign competition in our Colonial and foreign markets is to become even keener, and this demands an increased effort on the part of Englishmen. We are afraid that sufficient attention is not given to the trade hints set out in the reports of our consuls abroad. It is true that sometimes they are not so detailed as might be wished—(a point in which American consular reports often excel)—but even the general advice, apart from the commercial bureau information, is deserving of more than passing notice as a rule.

Ilford Electricity Works.—Switchboard.

A recent report in which the personal representation factor is strongly urged comes from Acting Consul C. L. Temple, in the province of Para. He discusses the reasons for the success of foreign competition there, and prominently among them he places the want of competent travelling agents of British race and language in the employment of British firms. Such agencies he regards as indispensable to the successful pushing of goods in the interior of the country. Mr. Temple believes that the foreign agents, especially the Germans, are distinctly superior to the British, especially in respect to knowledge and colloquial facility in the speaking at least of foreign languages. It appears that British firms, being unable to find travelling agents from their own country, have taken to employing foreigners in this capacity. It is pointed out in the report that this is peculiarly regrettable inasmuch as such men, however loyal to their British employers, can hardly help imparting to their own country, or countries, the information thus obtained whilst in the British service. The German travelling agent is content with less remuneration than his British colleague in the same service, but, having regard to the importance of the work, it is suggested that it would be well worth the while of British firms to allow the comparatively high salary for the sake of the increased custom that would result.

"The way," he says, "to advertise goods abroad is by means of capable travellers. A great proportion of the results commonly attributed entirely to the non-suitability of goods of British manufacture to the requirements of foreign markets should, I think, be traced rather to the insufficiency of travellers and special agents representing British firms. Illustrated catalogues and commercial literature are, I again repeat, quite useless unless presented and explained to possible customers by competent and interested agents."



Ilford Electricity Works.—E.P.S. Batteries.

What Mr. Consul Temple says about Para, is equally applicable to other parts of the world when he remarks:—"At

of personal and pushing effort. Catalogues and lists are

technical press has fallen in line with the feelings of the trade, and latterly nearly every number of some of our trans-Atlantic



present there is a real necessity for good travellers and agents of British nationality and sympathies, if British trade is not to lose ground, and it is not, I think, too much to suppose that these will be forthcoming."

It would be well if manufacturers and export houses generally would realise that it is an absolute necessity, if their interests are not to suffer very seriously, that capable travellers and agents resident abroad, of British nationality, should be found, trained, and employed. It would be hard to lay too great stress on this point.

The excuse that the works are full of orders and are turning out to their utmost capacity is not good enough. It will not hold water at the present moment when every other manufacturing nation is an active competitor. Pull down your barns and build greater! Make up your minds to get this foreign business and prepare yourselves to be in a position to turn it out with efficiency, economy and promptitude. Your competitors are not likely to beat you in the combination of the three-fold virtues.

Some reports that come to one's ears regarding the supineness, we had almost said stupidity, of English traders seem quite incredible. One such instance is recorded in a Foreign Office report on the trade of Dunkirk for 1900, by Mr. Consul Taylor. He says:—"The introduction of the metric system of weights and measures would, I think, help our manufacturers to hold their own in the increasing competition for trade, for buyers are much annoyed when they have to convert their orders from the metric system into our complicated weights and measures. A short time ago a large order was sent to a British firm, but as metrical weights and measures were given, it was returned with the request that, to have it executed, the buyer must reduce them into English weights and measurements. Comment upon this is scarcely necessary."

## TELEGRAPH AND TELEPHONE NOTES.

(*Continued from page* 976.)

**The New Anglo-German Cable.**—Reuter's agent at Nordenham states that on announcement of the laying of the new Anglo-German cable between Bacton and Borkum, the Emperor William sent a telegram to the North German Cable Works, which established the new connection, warmly congratulating them upon the accomplishment of the work, and expressing the hope that this new means of communication would serve to strengthen and consolidate the close relations existing between the German Empire and Great Britain.

**The Position of Telegraphists.**—The Postmaster-General has consented to receive a deputation to discuss the question of the rights of combination among postal and telegraph employés. The deputation is the result of correspondence which has recently passed between Lord Londonderry and the Secretary of the Joint Committee of Post and Telegraph Associations. Mr. Geo. Raby, the Chairman of the Joint Committee and member of the Executive of the Fawcett Association, and Mr. Chas. H. Garland, a member of the Joint Committee and Secretary of the London Branch Postal Telegraph Clerks' Association, will represent the 42,000 organised postal workers. Since the advent of Mr. Hanbury as representative of the Post Office in the House of Commons, there has been considerable improvement in the treatment of the postal unions by the authorities. Prior to this period no official cognisance was ever taken of the unions, and the appearance of the name of one of them in a communication to departmental chiefs was sufficient to ensure the rejection of the communication. This has now been altered, and the Secretary of the Post Office frankly enters into communication with the various unions on matters of interest to their members. The Postmaster-General, however, places certain restrictions upon the choice of representatives upon deputations to himself. He still insists that a representative must be suffering from the grievance he represents, or his interests must be identical with those of the aggrieved parties. This proviso prevents the representation of many grievances by the officials of the unions who have been elected for the purpose. The views of all the leading trade unionists of the country have been obtained on the matter, and there is a consensus of opinion that the right of combination is not granted in the Post Office, while restrictions are placed upon this cardinal point of selection of representatives. The date of the deputation has not yet been definitely fixed, but it will not be later than the present month. The announcement of the reception of this deputation caused much satisfaction among the men.

**Turkish Telegraphs.**—The *Levant Herald* states that the Turkish Administration of Posts and Telegraphs has applied for authority to invite tenders for the telegraphic material required for the line which is to join the Turkish system to that of India. Further, the Seraskierate demands the establishment of telegraphic lines between some of the more important towns of Syria.

### Telegraphic Interruptions and Repairs:—

| Cables. | Interrupted. | Repaired. |
|---|---|---|
| Latakia-Cyprus | June 20, 1899 | |
| Para-Maranham | March 1, 1900 | |
| **Landlines:—** | | |
| Bolama-Bissao | May 19, 1901 | |
| Cayenne-Pinheiro | April 20, 1901 | |
| Saigon-Bangkok | May 29, 1901 | |
| Pekin-Kalgan | June 14, 1900 | |
| Maimatchin-Kalgan | June 30, 1900 | |

**Women as Telegraphists.**—In the current number of the *Economic Journal*, an article appears under the above heading by Mr. C. H. Garland. The article is based upon the experience of the 35 administrations of the union which employ women, and the information is extracted from official reports, personal observation and facts obtained from divers other sources. The paper, which is of considerable length, gives very full details and statistics in support of the conclusions arrived at, which are briefly summarised thus:—

"Women possess the ability to perform the routine duties of telegraphy when carried on at low even pressure, as efficiently as men. A broader worldly education gives them the judgment and ability necessary to perform duties of a higher character. In addition they are attractive to employers, because they can be obtained considerably cheaper than men. They possess, too, the sovereign advantage of docility. There are not lacking signs, however, that this docility will decrease as women become more conscious of their economic value and responsibilities.

"As a set-off to their attractive qualities they suffer from certain disabilities and disadvantages which detract from their value and tend to neutralise the economy in money wages. They would appear to have a lower individual output than men, and as a consequence it is necessary to employ a far larger staff of women than of men for the same work. They suffer much more from sickness than men, which reduces their trustworthiness and value. This sickness is largely due to causes that are natural and inherent, and therefore ineradicable. Their average service is considerably shorter than men's, and they are thus lost at the period of their highest efficiency. They possess less powers of endurance and are therefore of much less value in certain emergencies, such as frequently arise in telegraph work. A social prejudice prevents the performance of night duty by women, although there seems reason to believe that this can and will be overcome. Weighing up the evidence which is to hand, we must be forced to the conclusion that the factor which turns the scale in favour of women is their docility. Doubtless the authorities are influenced to a considerable extent by the necessity of justifying themselves in adopting female labour. But after allowing for this influence, there does not seem sufficient reason for the very general declaration in favour of women unless we allow a tremendous value to their docility. It is quite certain that this characteristic of women is exceedingly attractive to busy administrative officers. With a male staff torn and agitated by the labour upheavals going on around them, there is doubtless much unrest and troublesome worry. Women are not affected by these disturbances. If this does not weigh as heavily as suggested, it is hard to understand the present position of heads of departments."

The article concludes with the following suggestion to the Post Office:—

"There is undoubtedly an excellent field for observation in the English Post Office, and many good results could be looked for if information were carefully collected, intelligibly classified and frankly published. In view of the importance of the subject, it is due to the public that some such work should be entered upon. Meanwhile our investigation of the material at hand whilst bringing out many important facts, still leaves the main question of the relative value of male and female labour in the present day to a large extent unsettled. But one result is, I think, quite certain: were it not for the docility of women there is no sufficient reason apparent to justify the favour with which they are viewed by administrative officers and others responsible for their employment."

The paper bears evidence of patient research and careful weighing of evidence, and should prove useful to all employers of female labour and those interested in the study of sex problems.

## CONTRACTS OPEN AND CLOSED.

### OPEN

**Belfast.**—June 21st. The Corporation wants tenders for sinking an artesian well, and supplying pumping plant. See "Official Notices" to-day.

**Belgium.**—Tenders are at present being inviting by the Belgian State Railway authorities in Brussels for the supply and erection of two shunt dynamos of 30-KW. capacity each, complete with pulleys, junction cables, rheostats, &c., required for the new power station at Jumet-Brulotte. Tenders are to be sent to La Bourse, Brussels, whence particulars may be obtained.

**Bradford.**—June 13th. The Corporation wants tenders for a switchboard for the Valley Road electricity works. Specifications, &c., from Mr. Chattock.

**Bermondsey.**—July 1st. The Borough Council wants tenders for electricity meters, demand indicators, and main fuses. See "Official Notices" to-day.

**Brazil.**—July 8th. The Foreign Secretary has received a despatch from H.M. Consul-General at Rio de Janeiro, stating that tenders are invited by the Brazilian Government, to be received not later than July 8th, for the supply of electrical machinery for the hoisting and transporting of locomotives at the Engenho de Dentro Works. Some particulars may be examined at the Commercial Department of the Foreign Office.

**Cleckheaton.**—June 22nd. The U.D.C. wants tenders for engines and dynamos. See "Official Notices" to-day.

**Eastbourne.**—June 7th. The Corporation wants tenders for 400 alternating meters, also 200-volt lamps. See two "Official Notices" May 24th.

**Eastbourne.**—June 8th. The Corporation wants tenders for economiser, feed heater, piping, tank, and crane. See "Official Notices" May 24th.

**Edinburgh.**—June 12th. The Council wants tenders for electric lighting installation at the Colinton Mains Fever Hospital. See "Official Notices" May 17th.

**Edinburgh.**—June 15th. The Corporation wants tenders for ash conveying plant for Dewar Place station. See "Official Notices" May 24th.

**Erith.**—June 24th. The U.D.C. wants tenders for Lancashire boilers, economiser, pumps, piping, condensing plant, steam alternators (high speed engines, three-phase alternators), switchboard, crane, transformers, sub-stations, mains and road work, arc lamps and posts, and station lighting. See "Official Notices" to-day.

**Exeter.**—June 28th. The Council wants tenders for water-tube boilers, steam alternators, switchboards, coaling apparatus, tanks, &c. See "Official Notices" May 10th.

**Farnworth.**—June 7th. The U.D.C. wants tenders for the overhead equipment of five miles of tramways, and tramway poles. See "Official Notices" May 24th.

**France.**—June 10th. The municipal authorities of Ardres (Pas de Calais) are inviting tenders until June 10th for the concession for the electric lighting of the town. Particulars may be obtained from, and tenders are to be sent to, La Mairie d'Ardres (Pas de Calais).

**Glasgow.**—June 10th. The Corporation wants tenders for branch rubber-covered cables. See "Official Notices" May 24th.

**Glasgow.**—June 10th. The Corporation wants tenders for electricity meters. See "Official Notices" May 17th.

**Great Yarmouth.**—June 26th. Tenders are wanted for additions to the electric lighting station. Specifications can be seen at the Town Hall. Tenders to Town Clerk, Town Hall.

**Ipswich.**—June 8th. The Corporation wants tenders for dryback marine type boilers 11 ft. 6 in. × 14 ft. long. See "Official Notices" May 17th.

**Islington.**—June 11th. The Lighting Committee wants offers for "free" or "assisted" wiring; also for painting arc lamp columns. See "Official Notices" May 24th.

**Leith.**—June 12th. Tenders are being inviting for a Sinclair's No. 1 Lancashire boiler, also steam piping at the electricity works. Specifications from the Burgh Electrical Engineer.

**London.**—June 12th. The Central Electric Supply Company wants tenders for three 20-ton and one 10-ton travelling cranes. See "Official Notices" May 24th.

**London.**—June 12th. The East Indian Railway Company is in the market for electric overhead travelling cranes. Specification to be seen at the company's offices. Tenders to Mr. C. W. Young, Secretary, Nicholas Lane, London, E.C.

**London.**—June 17th. The Guardians of St. Marylebone want tenders for electric light wiring and fittings for the new Able Bodied Block of their workhouse. See "Official Notices" May 31st.

**Mansfield.**—July 12th. The Corporation wants tenders for Lancashire boilers, stokers, pumps, economiser, 200-KW. steam generators, motor transformers, condensing plant, switchboard, battery, crane, mains, arc lighting, meters, and workshop equipment. See "Official Notices" to-day.

**Rochdale.**—June 7th. The Corporation wants tenders for six specimen electric tramcars. See "Official Notices" May 24.

**Spain.**—June 10th. The municipal authorities of Villanueva de Cordoba (Cordoba province), are inviting tenders until the 10th inst. for the concession for the electric lighting of the town during a period of six years. Particulars may be obtained from, and tenders are to be sent to, El Secretario del Ayuntamiento de Villanueva de Cordoba (Cordoba).

**Spain.**—June 10th. The Spanish Post and Telegraph department is inviting tenders until June 10th for the supply of 21 tons of copper sulphate for the telephone service. Particulars may be obtained from, and tenders are to be sent to, La Direccion General de Correos y Telegrafos, Madrid.

**Sutton Coldfield.**—June 15th. The Corporation wants tenders for D.C. meters and cut-outs. See "Official Notices" to-day.

**Taunton.**—June 11th. The Corporation wants tenders for one 250-KW. steam alternator, one 15-KW. motor-generator, switchboard extensions, water-tube boiler, superheater, condensing plant, piping, &c. See "Official Notices" May 24th.

**Walthamstow.**—June 14th. The U.D.C. wants tenders for electric light meters. See "Official Notices" May 31st.

**Warrington.**—June 13th. The Corporation invites tenders for boiler, 500-KW. engine (Willans) and dynamo, and mains, &c. See "Official Notices" May 24th.

**West Ham.**—June 25th. The Council wants tenders for three 500-KW. C.C. tramway-generators, and 850-I.H.P. steam engines; 11 water-tube boilers. See "Official Notices" to-day.

**Wigan.**—June 12th. The Electricity Committee wants tenders for a direct reading potentiometer, a direct reading photometer, tramcar wheels, and pit jack, car body lifting jack, and a Thomson's balance. See "Official Notices" to-day.

**Wigan.**—June 18th.—The E.L. and Tramway Committee wants tenders for 12 double-deck single truck electric cars. See "Official Notices" to-day.

**York.**—June 10th. The directors of the North-Eastern Railway wants tenders for the undermentioned articles, during the six months ending December 31st, 1901:—(1) Telegraph apparatus; (2) Telegraph wire and line stores. Payment for each month's delivery will be made at the end of three clear months, or in cash, less 2½ per cent. discount. Forms of tender may be obtained on application to Mr. Graves, Telegraph Department, York.

---

## CLOSED.

**Bristol.**—The Corporation electricity department has placed contracts as follows:—

AVONBANK ELECTRICITY WORKS.

| | |
|---|---|
| Foundations, retaining walls, culverts .. | E. Nuttall, Manchester. |
| Buildings .. .. .. .. .. .. | R. Wilkins, Bristol. |
| Boilers .. .. .. .. .. .. | Babcock & Wilcox, London. |
| Coal conveyor and elevator .. .. .. | Babcock & Wilcox, London. |
| Coal discharging plant .. .. .. | E. Benniss, Bolton. |
| Induced draught plant .. .. .. .. | Bumsted & Chandler, Hednesford. |
| Steam, electric, feed, and general service pumps .. .. .. .. .. | G. J. Weir, Cathcart, Glasgow. |
| Water softening plant .. .. .. .. | Doulton & Co., Lambeth. |
| Electric travelling crane .. .. .. | Higginbottom & Mannock, Manchester. |
| Steam alternators .. .. .. .. | Siemens, Willans. |
| Steam dynamos .. .. .. .. | Siemens, Willans. |
| Condensing plant .. .. .. .. | W. H. Allen & Sons, Bedford. |
| Steam and other piping .. .. .. | Babcock & Wilcox, London. |

GENERAL.

| | |
|---|---|
| Alternating current transformers .. .. | The British Electric Transformer Company, London. |
| Underground sub-station .. .. .. | E. Nuttall, Bristol, Manchester. |

TEMPLE BACK ELECTRICITY WORKS.

| | |
|---|---|
| Low tension switchboard .. .. .. | S. Z. de Ferranti, Hollinwood. |

**Dundee.**—A contract for a new engine and dynamo for the electric station has been placed with the International Electric Company (£4,000).

**Manchester.**—The Committee have accepted the following tenders:—The British Schuckert Electric Company, Limited, for two electrically-driven coal cranes; Messrs. Mather and Platt Limited, for four motors for driving mechanical stokers, and two spare armatures; Messrs. Babcock & Wilcox Limited, for 24 boilers of water-tube type, with all accessories complete; the Electrical Company Limited, for slow-speed (Yates & Thom) engines, three-phase generators, and motor-generators, with all accessories complete.

**Melbourne.**—The Postal Department have accepted the tender of Messrs. W. T. Henley's Telegraph Works Company, for the supply of 20 miles of lead-covered telephone cables at a cost of £4,992.

**Middlesbrough.**—The Corporation has accepted the following tenders in connection with the extensions to the Municipal Electricity Works, subject to the sanction of the loan by the Local Government Board:—

| | |
|---|---|
| Section A.—Boiler house plant: one 30 ft. by 8 ft. 6 in. Lancashire boiler and accessories, Holdsworth & Sons .. .. .. | £915 |
| Section B.—Engine house plant: one 300-KW. high-speed steam generator (Browett engine and Kolben dynamos) and pipework, Witting Bros., Limited .. .. .. .. .. | 3,564 |
| Section C.—Condensing apparatus: ejector condenser with circulating pumps, Crompton & Co., Limited .. .. .. | 557 |
| Section D.—Underground work: cables, troughing, trenching and boxes, British Insulated Wire Company, Limited .. .. | 737 |

**Nuneaton and Chilvers Coton.**—The Council at their last meeting gave the order for a "Meldrum Simplex" destructor to be erected at their sewage works to supply all power for pumping, &c. A similar plant has been working at Hereford Sewage Works for four years resulting, we are informed, in a saving of £400 to £500 per annum.

**Poplar.**—The Electrical Committee have accepted the tenders of Messrs. Mather & Platt, Limited, for the supply of 500 KW. generators, balancer, generator and booster, spare armature

and switch gear, at the sum of £10,371; and that of Messrs. Babcock and Wilcox, Limited, for the supply of two boilers, two chain grate stokers, two superheaters, Green's economiser, water softener, and extension of coal bunkers, at the sum of £4,482.

**Trafford Park.**—The Electrical Company, Limited, have obtained an order from Messrs. Browett, Lindley & Co., Limited, for one direct and three-phase current dynamo with one armature, 600 KW. on either side, for Trafford Park electric light and power station.

## NOTES.

**The Engineering Trade in 1900.**—The Amalgamated Society of Engineers attained its jubilee in 1900 with a membership of 87,672 and funds over £400,000. We ought to be thankful that it was not decided to celebrate the jubilee by a general strike. We believe that trade unions might be made to serve the true interests of their members if they were properly worked, but we do not hear that the policy of curtailed production has been abandoned, though it may have been less forced during the past few years than was previously the case. We think machinery ought to be forced to its utmost production, and when the proper time comes working hours should be reduced. We believe that if the Amalgamated Society of Engineers were differently managed, it might prove a potent influence in bringing our workshops into the front line. It is most unfortunate that the amenities of civilisation are the last things to be demanded by the A.S.E. We do not blame the workmen altogether for this. The employers are much in fault for having had filthy and disorganised shops for years, and having thus bred up an inferior class of workmen. While we do not believe in too much paternalism and patronage, we do think that every workshop should be a properly appointed place to work in, and we believe that having provided a decent workshop, an employer is justified in getting rid of all those who show their want of appreciation of cleanliness by being themselves dirty. It is fully within his rights to refuse employment to the unclean—indeed, it is his duty to the clean element to do so. We should be glad could we know that the A.S.E. has in any way been the custodian of its members' interests in such respects. As regards the importation by one or two railways of American locomotives, we are by no means certain that, in one case at least, there will not be repeat orders. When Mr. Barnes points out that these foreign engines were ordered because our own shops could not fill the orders, he appears to overlook the fact that our shops were not turning out the engines they ought to have turned out, partly because of their backwardness in tools and methods, but largely because of the men restricting output.

**Institution of Electrical Engineers.**—The following is the text of the illuminated address presented to the Institution of Electrical Engineers by the American Institute of Electrical Engineers, and read at the annual general meeting on May 30th, 1901 :—

The American Institute of Electrical Engineers has the honour to transmit with fraternal greetings to the Institution of Electrical Engineers of Great Britain the following resolutions:—

WHEREAS, the American Institute of Electrical Engineers, during the visit of its members to London and Paris in connection with the International Electrical Congress of 1900, and also in connection with the joint meeting immediately preceding the same, of the British Institution and American Institute of Electrical Engineers, held in Paris on the 16th day of August, 1900, was the recipient of many courtesies and much hospitality from the British Institution of Electrical Engineers.

RESOLVED—That the American Institute of Electrical Engineers herewith respectfully tenders to the Institution of Electrical Engineers of Great Britain its sincere thanks for the many courtesies extended to its members in connection with the above-mentioned visit to London, and with the joint meeting of the two Institutions in Paris, both of which have left many pleasurable recollections.

RESOLVED—That a copy of these resolutions be forwarded to the Institution of Electrical Engineers in London, and that a copy of the same be published in the *Transactions* of the American Institute of Electrical Engineers.

The above resolutions were unanimously adopted at a meeting of the Council of the American Institute of Electrical Engineers held in New York City, U.S.A., March 22nd, 1901.

(Signed) CARL HERING, *President.*
RALPH W. POPE, *Secretary.*

**Wireless Telegraphy and Torpedo Boat Destroyers.**—We hear that H.M. Destroyer *Orwell* is being fitted with wireless telegraphy apparatus in view of experiments during the forthcoming cruise of the Mediterranean Squadron. This is the second of a series of cruises which will be taken by the Squadron during the year, each to last about a month or six weeks. If the experiments in the *Orwell* are at all successful, they will be of enormous importance to the scouting section of the Fleet. Hitherto the inability of a Destroyer to communicate at long distances in the daytime has been a great drag upon her work, for any news that by her speed she is able to discover must either be passed to the Fleet through a connecting cruiser, or else she must return to within signalling distance, and thereby lose a lot of valuable time. From time to time experiments have been made with kites in place of tall signal masts, but these have not given any great satisfaction, and have never been seriously adopted. Wireless telegraphy has been thought up to the present impracticable, owing to the small capacity of such an aerial wire as could be hoisted to the mast-head of a Destroyer, but recent experiments with big condensers have shown that a large enough capacity should be obtainable, even with the very small height of a Destroyer's mast, to enable the messages thus sent to be "in tune" with the aerial wire of the flagship, and if this is demonstrated by the forthcoming manœuvres to be the case, one of the greatest problems of modern Naval warfare will have been solved.

**Institution of Electrical Engineers (Students).**—The report of the Committee of the Students' Section for the Session 1900—1901 reads:—

During this session 11 ordinary meetings have been held, the average attendance at which has been 20. At some of these meetings have been read some of the reports presented to the Institution by the student-reporters appointed by the Council of the Institution in August last, to report on various classes of exhibits in the Electrical Section of the Paris Exhibition of 1900. In addition, six papers have been read on various electrical subjects. Thirteen works and installations of special interest in the neighbourhood of London have been visited by parties of students during the session. Eight visits have also been made by parties of students from the various technical colleges to the Board of Trade Standardising Laboratory at the invitation of Mr. A. P. Trotter, of the Board of Trade. It is with great pleasure that the Committee reports the success of the visit of the students' section to Manchester in April last.

The proposal to visit an engineering centre in the Easter vacation of the technical colleges was brought forward in December last, and with the approval of the Council, a circular letter was sent to all the student-members in order to test whether the proposal would meet with sufficient support. To this circular 33 replies were received, and it was considered that there was a sufficient number to warrant arrangements being made for the visit to take place. Manchester was chosen as the centre for the visit. The visit lasted four days, from Tuesday, April 16th, to Friday, April 19th (one day, Thursday, April 18th, being spent at Liverpool), and was participated in by 32 students, 11 of whom were from London, the majority of the remainder being from the neigbourhoods of Manchester and Sheffield.

The party was well received by the firms and engineers whose works were visited, and the success of this visit leads the committee to hope that the experiment may be repeated in future years.

The committee for the coming session is made up of the following gentlemen:—B. H. Morphy and C. W. Wilkinson (Central Technical College); A. H. Bennett (Faraday House); R. L. Longman, P. G. Mitchell and P. Rayner-Smith (Finsbury Technical College); D. R. H. Browne (King's College); F. J. Hiss, jun., and H. D. Symons (non-collegiate); G. B. Dyke (University College).

**The Bowman Lindsay Monument.**—The committee which has had in hand the matter of erecting a monument in memory of J. Bowman Lindsay at Dundee has adopted a design for the memorial, which it is proposed to unveil early in September, when Sir W. H. Preece and other electrical men, who will be subsequently visiting the B.A. meeting at Glasgow, will be able to take part in the ceremonial.

**The Royal Society.**—Among the papers down for reading yesterday were the following:—Prof. J. C. Bose, "On the Electric Response of Inorganic Substances," preliminary notice; Dr. Waller, F.R.S., "On Skin-Currents. Part I.—The Frog's Skin;" G. F. C. Searle and T. G. Bedford, "The Measurement of Magnetic Hysteresis."

**Obituary.**—We regret to learn from the columns of the *Times* of the death, which occurred at Geneva, on Sunday, after a long illness, of Principal John Viriamu Jones, Principal of, and Professor of Physics in, the University College of South Wales at Cardiff. In 1881 he left Oxford to become Principal of, and Professor of Mathematics and Physics in, Firth College, Sheffield. Two years later, on the establishment of the University College of South Wales, he was appointed its first Principal, also acting as Professor of Physics; and this position he retained up to his death. In 1894 he was chosen a Fellow of the Royal Society. His scientific work was mainly concerned with the measurement of electrical resistance, and he was a member of the committee of the British Association on that subject. In particular he was deeply interested in the determination of the standard ohm by the Lorenz method in absolute measure—*i.e.*, conditioned only by the units of length and time and the properties of the ether; he constructed a Lorenz apparatus for his laboratory at Cardiff, and took a prominent part in designing and testing another that was made in London for the McGill University. The cause of technical and scientific education in Wales owed much to his powers of organisation.

Sir Andrew Fairbairn, chairman of Fairbairn, Lawson, Combe, and Barbour, Limited, machine makers, Leeds and Belfast, died on Friday night at his London residence, Portland Place.

Among readers of the Electrical Review there are many who will learn with deep regret of the passing away of Mr. Frederick Thornton, who for over 30 years has moved among telegraph engineers in this and other parts of the world in construction work. One of his first engagements was in the Indian Telegraph Service, which he left to join Messrs. Latimer Clark, Muirhead & Co. After a short time, however, he entered into an engagement with the E.P.S. Co. at Millwall, but in 1888 returned to Messrs. Latimer Clark in order to go to Australia, where he superintended the construction of the telegraph line from Roeburn to Perth. Previous to this, however, he had taken part in the erection of lines in South Africa, and what was then known as the Orange Free State. In the year 1895 he became London manager of the Wigston Electrical Works, and at the termination of this engagement he went out to Central Africa, in August, 1898, as chief engineer to the Mohun Expedition, whose mission was to construct a telegraph line across Central Africa for the King of the Belgians. The route of this line was from Mtowa, on Lake Tanganyika, to Kasonga, on the Congo—a distance of 200 miles, and from thence to Stanley Falls, another 400 miles. It was at Kasonga that Mr. Thornton met his death on March 4th this year. He was 54 years of age. The many engineers who remember him will join with us in sincerely condoling with the relatives he has left behind.

---

**The Municipal Electrical Convention.**—The official programme of the annual convention of the "Incorporated" M.E.A., which opens at Glasgow on Wednesday, June 19th, has been issued, and the secretary, Mr. C. McArthur Butler, has favoured us with a copy. Mr. W. A. Chamen will deliver his presidential address on June 19th, after the company has been welcomed by the Lord Provost of Glasgow. Two papers will then be read and discussed separately—(1) by Mr. J. H. Rider on "Uninsulated Returns in a Tramway System," and (2) by Mr. Bailie W. Maclay on "Street Electric Lighting." Visits will subsequently be paid to the Corporation electric tramways and lighting stations. The next day's meeting (June 20th) will be held at Edinburgh, and the papers down for reading are (1) "Braking Apparatus for Electric Cars," by Mr. A. L. C. Fell; (2) "The Equitable Allocation of Costs in Combined Lighting and Traction Stations." Visits will afterwards be paid to the Edinburgh Corporation electricity works, the cable tramways power-stations, the works of Messrs. Bruce Peebles, and Messrs. Mackenzie Bros. On Friday, Glasgow will again be the place of meeting, and the papers are—(1) "Refuse Destructors in Combination with Electric Power Stations," by Mr. J. S. Highfield; and (2) "Coal and Ash Conveying Gear," by Mr. R. A. Chattock. Visits are arranged for to the Corporation car works and the manufactories of Messrs. G. & J. Weir, Messrs. Mavor & Coulson, Messrs. Aird & Coghill, the Singer Manufacturing Company, and Messrs. Brown Bros.' shipbuilding yard. At the business meeting which will be held on Friday evening, one of the items to be considered is, "The Advisability of Formulating a Set of Rules for the use of the Police in cases of emergency arising out of Breakage of Overhead Trolley Wires." For those who stay in Scotland for Saturday, a visit to the works of Babcock & Wilcox, and several excursion arrangements are suggested. The meeting, if we may judge from the programme, promises to be exceptionally interesting and successful. The mistake of trying to crowd too many papers into three days' meetings has not been made, and the authorities are to be congratulated upon the point. It is desired that the fact should be made as widely known as possible that visitors, whether members or not, are cordially welcome to take part in the meetings. The necessary tickets can be obtained by applying to Mr. Butler, the secretary, at St. James's Hall, Piccadilly, W. On June 12th Mr. Butler leaves for Windsor Hotel, Glasgow, to which address letters should be sent.

---

**Proposed "Henry Angel Memorial."**—In February last while in the active discharge of his duties as instructor in steam, applied mechanics, &c., at the City of London College, Mr. Henry Angel was overtaken by a paralytic stroke from which death resulted. It is now proposed by those who best knew him and his work to found a prize or scholarship to perpetuate his memory at the college. Many of those who studied under the late professor will, we feel sure, be only too glad to be afforded an opportunity of contributing toward this very commendable object. They will remember the signal success which accompanied his labours both at the City of London College and elsewhere; and will need no reminding of the fact that in spite of natural infirmities, he was ever most accessible as a teacher, and would put himself to an endless amount of trouble in order to help his students to master difficult problems. By such unceasing labours he gained the high esteem and love of all with whom he came in contact. His colleagues testify that he was a grand teacher and thorough gentleman. Subscriptions to any amount will be thankfully received and acknowledged by Mr. P. J. Gillbard, hon. secretary of the "Henry Angel Memorial Fund," City of London College, White Street, E.C.

---

**Institution of Electrical Engineers (Awards).**—The annual general meeting of the Institution of Electrical Engineers was held at the Society of Arts on Thursday last week, Prof. Perry in the chair. The following premiums have been awarded for papers read:—The Institution premium of £25 to Mr. M. O'Gorman for his paper on "Insulation of Cables;" the Paris Electrical Exhibition premium of £10 to Mr. W. Duddell for his paper on the "Rapid Variations of the Current through the Direct Current Arc;" the Fahie premium of £10 to Mr. A. C. Eborall for his "Notes on Polyphase Sub-Station Machinery;" an extra premium of £10 to Mr. J. S. Highfield for his paper on "Storage Batteries in Electric Power Stations Controlled by Reversible Boosters;" and four extra premiums of £5 each to Mr. M. B. Field for his paper (Glasgow Local Section) on a "Method of Compensating Voltmeters for Voltage Drop in Large Feeders;" to Mr. W. Wyld for his paper (Birmingham Local Section) on "Polyphase Equipment of Factories;" to Mr. G. Ralph for his paper (Newcastle Local Section) on "Electrically-Driven Machine Tools and their Advantages;" and to Mr. F. Holden for his paper on "A Watt-Hour Meter." Students' premiums were awarded to Mr. C. B. Nixon, Mr. F. J. Hiss, jun., Mr. J. H. Vigor, and Mr. J. H. West. The two Salomons scholarships were awarded to Mr. J. D. Griffin and Mr. H. A. Skelton, and the David Hughes scholarship to Mr. C. J. Hopkins.

---

**Appointments Vacant.**—An instructor in electric wiring, and a student demonstrator in mechanical and electrical engineering are wanted for the Battersea Polytechnic. A charge engineer is wanted for Bristol at £3 per week, and a meter inspector for Nelson. A mains assistant and draughtsman, and other assistants, are required for Islington electricity works. The Glasgow Corporation wants men for telephone instrument fitting, and switchboard construction.

**Personal.**—Mr. Philip Powter, resident engineer of the Camp's Bay (Cape Town) Tramway Company, Limited, was recently the recipient of an illuminated address, signed by nearly 100 of the employés of the company. On the same occasion a silver tea and coffee service and a handsome album were presented to Mrs. Powter and Miss Kathleen Powter respectively. The presentation was made by Mr. Hackwood, assistant engineer. During the evening Mr. C. P. Wilson, the new general manager and electrical engineer of the company, conveyed his thanks to Mr. Powter for the assistance rendered to him in taking over the reins of office.

Mr. R. W. Grubb has been appointed assistant engineer at the Eastbourne electric light works.

Owing to re-arrangement of the staff of the Edison and Swan Company, Mr. A. W. Hill will be severing his connection with the same after an uninterrupted period of 20 years. Mr. Hill joined the staff of the American Edison Company before the formation of the English company, and was superintendent of the Central Station, Holborn Viaduct, with charge of the erection and maintenance of all the installations in London and district for the Edison & Swan Company. Mr. Hill has held the position of works foreman and engineer for the last 10½ years at the Ediswan Factory, Ponder's End.

Mr. C. B. Elliott, general manager of the Cape railways, who has been commissioned by the Cape Government to visit Europe and America for the purpose of selecting rolling-stock, signalling, and electrical appliances for the South African railways, has arrived in this country.

Mr. A. V. Clayton, formerly of the B.T.H. Co., who accepted an appointment some months ago with the Elektriska Aktiebolaget Magnet, Ludvika, has become engaged to Miss Tyra Unga, daughter of Mr. A. Unga, of Henriksholm, Sweden.

---

**Electric Blowing at Lincoln Cathedral.**—Just as we go to press the following letter comes to hand from Mr. Arthur Bergtheil :—"I am afraid I must trouble you once again for a short space to answer Mr. Hutton. He admits fairly enough that the alterations which my firm made to our original installation in the Cathedral were necessitated by a misapprehension on the part of the organ builders, and he goes on to state that the apparatus was not even then wholly satisfactory. I do not complain of that, for I believe it is correct ; but what I do complain of is, that Mr. Hutton should go out of his way in the most unfair manner to suggest (as his letter does) that this unsatisfactory state of affairs was due to any incompetence or bad workmanship on the part of my firm, instead of to attempt to make the best of a bad business, and adapt the plant and gear designed for 30 revolutions on two winds to 5 and 7 revolutions on two winds—a difficulty which even Mr. Hutton has apparently only overcome, according to his own account, by almost an entirely new installation. Mr. Hutton forgets to add that our estimate for further alterations—made after consultation with him, and at his request, and which, in our opinion, would have overcome the difficulty, and which he described as chiefly mechanical—only amounted to £38." We think it is now time that this correspondence came to an end.

---

**Marriage.**—On 29th ult. Mr. Arthur Hart, manager of the electrical department workshops of Messrs. D. Bruce Peebles & Co., of Edinburgh, was married to Miss E. F. Bradley, of Blackheath. The staff and employés at the Tay Works presented the happy couple with a handsome chest of cutlery.

---

**City and Guilds Institute.**—On Tuesday, June 18th, Lord Avebury will open an exhibition of students' practical work, executed in connection with the Institute's technological examinations, at the hall of the University of London. The exhibition will be held in the north gallery of the Imperial Institute.

---

**Appointment.**—Mr. J. V. Moinet, of Tunbridge Wells, has secured the appointment of mains superintendent to the Reading Electricity Supply Company.

**American Machine Tools.**—Our New York namesake delivers itself as follows :—"For the past few weeks the lack of orders for American machine tools from the London market is said to be more noticeable than ever. From each and every market comes a different excuse for the existing conditions. The manufacturers' agents in London claim that the market there is overstocked with our products, and until those are disposed of the demand will be dull. Berlin representatives say that German imitations of American machine tools are slowly driving out the genuine article. The agents in France, and there are but few, state that a great deal of machinery and tools from the Exposition was sold after it was closed in open market, and a little time will be required before new sales can be made. As the agents in France, Germany and England practically control the trade for the rest of Europe, there is hardly any business being done."

---

**Glasgow Exhibition.**—It is expected that the King will visit the Glasgow Exhibition on his way to the Highlands next month.

## OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

**Guildford Electricity Supply Company** (36,725).—This company's annual return was filed on April 24th, when 2,586 ordinary and 500 founders' shares were taken up out of a nominal capital of £20,000 in 3,900 ordinary shares of £5 each, and 500 founders' shares of £1 each. The full amount has been called up on each share, resulting in the receipt of £13,440 ; £2 has been paid on two forfeited shares ; mortgages and charges, £3,450.

**County of London and Brush Provincial Electric Lighting Company** (34,320).—This company's annual return was filed on May 13th, when 20,000 preference and 40,000 ordinary shares were taken up out of a nominal capital of £800,000 in 40,000 preference and 40,000 ordinary shares of £10 each. £600,000 has been paid. Mortgages and charges, £400,000.

**Smithfield Market Electric Supply Company, Limited** (53,354).—This company's annual return was filed on March 7th, when 12,000 shares were taken up out of a nominal capital of £100,000 in 20,000 shares of £5 each. £5 per share has been called up, resulting in the receipt of £60,000. Mortgages and charges, £58,000.

## SUPPLY STATION ACCOUNTS.

**Hanley Corporation Electricity Accounts.**

The accounts for last year show that the Hanley Corporation electricity works are in a very much improved position compared with previous years. Notwithstanding the increase in financial charges of over £800 the net loss has been reduced to very nearly what it was in 1898, or under a third of the figure for 1899. The gross profit is about three times that of 1899, and 50 per cent. greater than in 1898. Mr. Lobley, the borough engineer, has been proved correct, when he said that there is "no cause for apprehension as to the future financial success of the undertaking." The load has risen considerably less than the units in proportion to the respective totals, the output being roughly increased by 20 per cent. This shows that whether the demand indicator principle is understood or not by the consumers in Hanley, it is decidedly to the benefit of the undertaking that it should be retained.

General Statement.

| | 1899. | 1900. | Inc. |
|---|---|---|---|
| Total capital expenditure ... | £67,829 | £73,330 | £5,501 |
| Number of units sold ... ... | 537,893 | 643,200 | 105,307 |
| No. of lamps, 32-watt, connected | 35,160 | 41,612 | 6,452 |
| Maximum load ... ... ... | 550 | 634 | 84 |
| Gross revenue ... ... ... | £8,809 | £11,699 | £2,890 |
| Gross expenditure... ... ... | £7,632 | £8,068 | £436 |
| Gross profit ... ... ... | £1,177 | £3,631 | £2,454 |
| Average price per unit sold ... | 3·80d. | 4·24d. | +·44d. |

We are glad to note that the rates charged are 6d. and 3d. for lighting, and 3d. and 1d. for power, instead of 5d. and 2½d., and 2½d. and 1d., as was the scale prior to August last year. The special rate to churches was 4d., and is now 4½d. As a result the receipts from energy sold have improved by nearly ½d. per unit and stand at 4½d., a reasonable figure for two-thirds of a million units output.

REVENUE STATEMENT.

| | 1899. Gross. | 1899. Per unit. | 1900. Gross. | 1900. Per unit. | Inc. |
|---|---|---|---|---|---|
| Sale of energy .. .. | £8,515 | 3·80d. | £11,354 | 4·24d. | +·44d. |
| Meter rents .. .. .. | 268 | ·12d. | 287 | ·11d. | −·01d. |
| Supply of old material, &c. | 26 | ·01d. | 45 | ·02d. | +·01d. |
| Sundry receipts: law expenses returned. | — | — | 13 | ·00d. | — |
| Gros revenue ... | £8,809 | 3·93d. | £11,699 | 4·37d. | +·44d. |

The engineering costs, with exceptions of coal and rates, have improved, and the works and total costs show better by ¾d. per unit in consequence. Oil, wages, and repairs are reduced in the gross, upon which Mr. Conelle, the Corporation electrical engineer, is to be congratulated.

COST OF PRODUCTION.

| | 1899. Gross. | 1899. Per unit. | 1900. Gross. | 1900. Per unit. | Inc. |
|---|---|---|---|---|---|
| Coal .. .. .. .. | £2,540 | 1·13d. | £3,134 | 1·17d. | +·04d. |
| Oil, waste, water and engine room stores. | 460 | ·20d. | 273 | ·10d. | −·10d. |
| Salaries and wages incurred in generation and distribution, and attendance street lamps. | 1,412 | ·63d. | 1,389 | ·52d. | −·11d. |
| Repairs and maintenance of engines, boilers, buildings, dynamos, &c., and renewals street lamps. | 1,988 | ·89d. | 1,768 | ·66d. | −·23d. |
| Works costs ... | £6,400 | 2·85d. | £6,564 | 2·45d. | −·40d. |
| Rent, rates and taxes .. | 585 | ·26d. | 753 | ·28d. | +·02d. |
| Management expenses, salaries of managing engineer, secretary, clerks, &c. | 507 | ·23d. | 593 | ·22d. | −·01d. |
| General establishment charges, stationery and printing, law charges and insurance | 140 | 06d. | 158 | ·06d. | −·00d. |
| Other expenses .. .. | — | — | — | — | — |
| Total costs ... | £7,632 | 3·40d. | £8,068 | 3·01d. | −·39d. |

From the General Statement it will be seen that the costs increased by £436, but revenue by £2,890, the difference, £2,454, going to swell gross profits. As the financial charges took £826 extra only, the remainder, or £1,628, went to reduce the loss of £2,269 in 1899 to £641 in 1900, and we hope to see the corner turned in the current year.

PROFIT STATEMENT.

| | 1899. | 1900. |
|---|---|---|
| Interest on loans and overdraft .. .. .. | £2,131 | £2,124 |
| Sinking fund for repayments .. .. .. | 1,315 | 2,148 |
| Net profit carried forward .. .. .. | −2,269 | −641 |
| Gross profit ... ... ... | £1,177 | £3,631 |

# CITY NOTES.

## The Castner-Kellner Alkali Company.

MR. W. MATHER, M.P. (Chairman), presided on Thursday last week, at Winchester House, E.C., over the fifth ordinary general meeting of the shareholders of the above company, and, in moving the adoption of the report, said his remarks would naturally be made in relation to the earnings of the business not having enabled the directors to pay during the year just closed the usual dividend which the company had paid since it first commenced to work. He was glad to say the reasons for the present position were of a simple character, and involved no kind of complication in connection with their enterprise. In the first place he would allude to the fact that the absorption of the Aluminium Company by the Castner-Kellner had been in due course completed, and they had every reason to believe that the amalgamation was a very wise and politic step on the part of the Castner-Kellner Company, and also on behalf of the Aluminium Company. In dealing with the question of their reduced earnings, he had to state that in the first place the increased price of coal and raw materials had meant a difference of £11,000 to their net profit. But notwithstanding that fact, in the month of October last they considered that they were justified in paying an interim dividend at the rate of 8 per cent. per annum. As that matter might be subject to criticism, it would be desirable that he should explain the reasons which led them to take that step. At the time of the interim dividend being paid they were in the first part of the third quarter, and they were making deliveries of bleaching powder to the utmost capacity of their works, and the outlook and the prices were so promising that they had no hesitation in adopting the same plan which they had pursued since the company was started, of paying the dividend, feeling sure that at the end of the year they would be able to show the same results as previously. They were justified in the forecast, not only because of the encouraging view of the general manager, but in consequence of the sales being made, and the fact that in December they were producing and selling a larger amount of bleaching powder than in any month before. The price of bleaching powder had increased considerably, and there seemed a probability of a yet higher price being reached. At the turn of the year an extraordinary change took place in the alkali trade, especially affecting bleaching powder, which he could truthfully say took everyone by surprise. What almost amounted to a collapse occurred, and stagnation had remained in the trade ever since, and instead of them increasing their output they had suddenly to diminish the manufacture of the powder, and at the same time to increase their stocks. He attributed the unanticipated result of the trade principally to that cause. Another cause was with regard to caustic soda, the production of which was of necessity diminished because the production of bleaching powder and caustic soda went on simultaneously. Then they had to face the inevitable delay in getting their new sodium works erected at Weston Point, although the work had been extremely well carried out, and they were now in perfect order with the newest improvements, and in all respects satisfactory. They had anticipated when they had paid the interim dividend that the war would soon be at an end, and that the gold mines would be re-opened, for their production of sodium mainly depended upon the re-opening of the gold mines. The continuation of the war had resulted in their not securing the full amount of profit they anticipated from the absorption of the Aluminium Company. In conclusion, the Chairman said that the three causes for the diminished profits, were increase in cost of coal, the abnormal state of the bleaching powder market, and the continuation of the war. If any one of those three causes were removed it would make a great difference to their earnings, and if all three were removed they would be in a very excellent position indeed.

MR. BEILBY seconded the motion.

Several shareholders criticised the accounts and expressed disappointment that better results had not accrued from the amalgamation with the Aluminium Company.

The CHAIRMAN, in answer to criticisms, said that in absorbing the Aluminium Company they had secured the goodwill and patents, and had bought up a going concern representing a business of considerable value. What they wanted to do was to enlarge the field of their electrolytic work, and not to be dependent upon the bleaching powder market or the caustic soda market. The war had had an overwhelming effect on the production of sodium, which was used in the gold mines. However, they were not disappointed with the Aluminium Company, for it had fairly contributed to the results of the year.

The report was then adopted.

## India-Rubber, Gutta-Percha and Telegraph Works Company.

MAJOR DARWIN presided at the half-yearly meeting of this company, held on Tuesday at Cannon Street Hotel. He said that since December last the prices of raw materials, with the exception of gutta-percha, had eased, and they had been able to sell their manufactures at lower prices than ruled for the previous 18 months. The reductions had not been considerable. As a result of this and the general slackness in trade, the turnover did not compare favourably with that of the similar period last year. An improvement had now taken place, and the board hoped that they would meet the shareholders in December with a statement of affairs showing much the same results as were laid before them six months ago. The company had just completed the laying of a cable for the Commercial Cable Company between Weston and Waterville, and the *Buccaneer* had just terminated her charter with the Western Telegraph Company. Owing to the continuation of hostilities the South African agencies were not able to do any work, but when matters settled down they would be ready to take advantage of every opening for business which might present itself. With reference to his earlier remarks, it would be understood that the price of gutta-percha had not fallen. Those remarks might cause a false impression. The market prices for the different grades of gutta-percha were, as a matter of fact, lower than they were recently, but the quality of those grades was below the usual standard, with the net result that buyers got less useful material for the money they paid than was formerly the case. To enable the company to increase its facilities for production at the French works small neighbouring property had been purchased. This step had been rendered necessary by reason of the fact that during the past three or four years they had been much hampered for want of room.

A resolution approving an interim dividend at the rate of 2½ per cent., or 5s. per share, was carried.

The CHAIRMAN, in concluding the proceedings, announced that during the period under review the board had sustained very great loss by the retirement of Mr. Gray and Mr. Silver. Only those who had been on the board could thoroughly appreciate what a great loss that was to the company. The loss was mitigated, because they had been able to appoint both of those gentlemen extraordinary directors under the alterations recently made in the articles. They had secured the services of Mr. George Henderson, an old shareholder and son of a former chairman, and Mr. Charles Moore, a West Indian merchant, to fill those places on the board.

The usual vote of thanks closed the meeting.

## Electric Power Distribution Company.

MR. W. L. MADGEN (managing director) presided at Surrey House, on Tuesday, over the fourth ordinary general meeting of the above company, and in moving the adoption of the report, said the profits had amounted to £15,001 2s. 9d., and after deducting the proportion

of general expenses chargeable to revenue, and the expenses incurred in connection with schemes not proceeded with and written off, and a sum of £1,271 5s. 9d., held in reserve in respect of new schemes in course of development, there remained a net profit of £13,045. They proposed to write off the whole of the preliminary expenses, amounting to £826 6s. 2d., and the furniture account, which was a small one, was reduced by 20 per cent., and in time that small item would disappear entirely. Income-tax amounted to £513 17s. 8d., and they recommended a dividend at the rate of 5 per per cent. per annum on the ordinary shares for nine months, which took £1,320, leaving the large sum of £10,329 to be carried forward. They had a very large amount of work in hand, and they felt that it would be a judicious course, as part of that work was not yet completed, to carry forward that amount. He felt confident that they would not have to trench upon it in any way, when they presented their report at the end of the current year, and indeed they fully expected that the rate of profit which had accrued to them during the past nine months would be fully maintained. There was only one other item in the report to which he need draw their attention, and that was the sum at which the schemes they had now in hand had been taken into the balance-sheet. The first item on the credit side of the balance-sheet was "expenditure on power Bills and negotiations in connection with new schemes in course of development, less amount reserved £16,840 13s. 6d." They felt that that amount was fully justified by the value of those claims which they had in process of development. It represented undertakings which were in process of development and negotiation with a view to being at a later stage put into practical shape—the stage at which the works would be constructed, and be available for revenue purposes. This sum of £16,840 represented the net cost of those power Bills and other negotiations which were proceeding, and, of course, nothing had been added to that amount in taking it into the balance-sheet. The attention of many would have been drawn to the vast strides which had been made in connection with electrical work in America and on the Continent and in their Colonies. That progress had been relatively more rapid than it had been with them at home, but many of them felt, some few years ago, that the time had arrived when there was a good promise for similar undertakings in connection with electrical power distribution proving remunerative in this country. It seemed necessary, at the same time, in the interests of the country, that something should be done to give their industries the same facilities which similar industries enjoyed in other countries. The latter suggestion was a sentimental one, and would have attracted but a sentimental interest on their behalf had it not at the same time afforded promise of a good investment. They went to work, and he believed they had met with a very fair measure of success. In the session of last year four Bills for the distribution of electrical energy on economic conditions over very large sections of country passed through Parliament. Of those the company secured two, and over districts which he thought were exceptionally favourable, viz., the County of Durham, which was one of the greatest industrial centres in the country, and the North Metropolitan District, which had exhibited in past years an enormous increase of population in the residential districts, and which also of more recent years showed a tendency to industrial development along the valley of the Lea. The cost of these Bills was included in the item in the balance-sheet to which he had referred. In addition to those power Bills they had secured rights for electricity supply in Banbury, Sheerness, Sevenoaks, Wellingborough, Sutton and District, in Surrey, Lewes, Penarth, Staines District, and Weston-super-Mare. These latter powers, while not offering such large powers for investment as the power Bills, yet were in some cases the nucleus of what might be equally large undertakings later on. As he said, the County of Durham and the Metropolitan Power Bills were obtained in the autumn of last year, and the work was immediately put in hand, and last month they successfully inaugurated the main power station at Gateshead under the County of Durham Bill. Their friends the British Electric Traction Company had begun a very extensive system of electric tramways, and the first business undertaken by the station to which he referred was to supply those tramways with electric energy. The general electricity supply for the town of Gateshead and the neighbouring districts was making very rapid progress, and they were led to believe that their confidence as to the suitability of the district for electric power purposes would be fully justified, as consumers were beginning to take a supply very readily. With regard to the North Metropolitan scheme, that would be commenced with two power stations both on the River Lea, where facilities for coal and water supply were probably the best in the north of London. Progress was made in that district with just as little delay as they permitted themselves in the case of the Durham scheme, and during the present month the first main station would be inaugurated at Hertford. Of the other schemes which he had referred to, the most interesting, perhaps, was Weston-super-Mare. The electricity supply for that town was inaugurated during the past month, and they started with a very satisfactory number of consumers, and that number was steadily increasing from week to week. The Weston-super-Mare company had a concession for a system of electric tramways for that town, and the construction of these lines, which would be worked in association with the electricity supply, would be commenced during the autumn of the present year. Most of the other stations referred to would be completed during the present year, and there were indications which reached them from those districts that satisfactory and profitable business would be done. It was the one object of the company to bring the electricity supply of those districts within reach of all classes upon the most favourable terms. There were clear indications not only abroad but in this country that the era of the separate little generating stations for each town or district was passing away, and that the era of electric power distribution on a large scale was now beginning. The operations of that company and the steps they had taken placed them directly in the line of development. They felt that they had made a good start, and felt pretty confident that they would derive a large measure of success from the business which had already been inaugurated and that which they had taken steps to secure for the years to come.

Mr. R. P. SELLON seconded the motion, and the report was adopted.

The retiring directors and auditors having been re-elected,

An extraordinary meeting was held, at which various alterations in the articles of association were agreed to. The alterations were due generally to the provisions of the new Companies' Act, and the CHAIRMAN stated that they were all in the interests of the shareholders.

## Barcelona Tramways Company.

THE report of the directors to be presented to the meeting on the 12th inst., states that in the year 1900 the traffic receipts from electric traction amounted to £85,589, and from mule traction to £13,157. Adding sundry receipts, the total receipts amounted to £99,872. Working expenses amounted to £69,729, leaving as gross profit £30,143. Deducting loss on exchange, £9,234, and adding amount brought forward, £1,211, the net profit is £22,120. The directors regret that the accounts do not enable them to recommend a dividend on the ordinary shares; various circumstances have brought about this result. The receipts from mule traction (which was not entirely superseded by electricity until October 4th last) were absorbed by the working expenses. The abnormally high price of fuel ruling during the greater part of the year added materially to the working expenses. The cost of fuel has now been reduced, and may be expected during the current year to compare favourably with that of the preceding year. The grant of the concession for working the Ensanche system by electricity is now only subject to certain formalities; when these are settled the directors hope to enter into a lease or working agreement to the mutual advantage of both companies. A new concession to be worked by electricity has been obtained for an extension of about 1½ miles of one of the company's principal lines; this, the board is satisfied, will be of considerable value, and the work of construction will be taken in hand without delay.

## Prospectuses.

As we anticipated in our last issue, a prospectus has this week been placed before the public inviting applications for 85,000 £1 shares in Messrs. Drake & Gorham, Limited, out of a total of 125,000 shares, all £1 ordinary, which represents the total capitalisation. The vendors take the remaining 40,000 shares in part payment of the purchase price, their other receipt being £66,000 in cash. The prospectus states the profits for each of the past five years, and these average £11,755 per annum. For 1900 they were £12,348, and for 1899 a little in excess of that. Taking these two years as a basis, it is estimated that after payment of management charges and directors' fees, and placing a sum to reserve, 8 per cent. per annum can be declared on the capital. The assets, less sundry creditors, are put down at £40,000. Messrs. B. M. Drake and J. M. Gorham, the vendors, will act as managing directors for the next seven years at £500 per annum each. The business will accordingly be continued on the lines that have made it so successful in the past. The minimum subscription on which the company will proceed to allotment is £85,000 exclusive of the vendors' allotment shares. In our last issue we mentioned the general character of the business, and indicated the progressive future that should be before it in view of the great electrical development now evident in all parts of the country. The list of subscriptions opened last Monday, and closed yesterday (Thursday).

A prospectus of the Uxbridge and District Electric Supply Company has been in local circulation.

## Electric Lighting Boards, Limited.

WE are informed that in the course of a meeting of the shareholders held at their offices, No. 7, Pall Mall, it was announced that the American rights of the "E.L.B." system have been disposed of for a very considerable sum, the first cash payment which was recently cabled alone amounting to £15,000. As Admiral Sir Henry Nicholson, K.C.B., the chairman of the company, remarked, the purchase has a far wider interest than the mere financial side, seeing that Americans are particularly chary of electrical inventions hailing from Europe, and it speaks well for the system to have successfully passed all the electrical patent and insurance ordeals to which such inventions are subjected in the States. The negotiations for the sale, by the bye, were conducted entirely by Miss Amy Ashton Bence, the secretary of the company, who visited New York, and the estimation in which her services are held by the shareholders may be gauged by the substantial cheque which was handed her in connection with a vote of thanks proposed by Sir James Weeks Szlumper, M.Inst.C.E. (Mayor of Richmond), seconded by Mr. Passmore, M.I.M.E. (late manager of the New Zealand Government railways), and by the presentation of a set of plate to her on the part of the directors in their personal capacity. Miss Bence was formerly the right hand of the late Sir Augustus Harris. The prospects of the company appear to be excellent, business already having commenced in

several foreign countries, as well as in England, and the directors have already declared an interim dividend at the rate of 20 per cent. on its first year's working. A demonstration of recent improvements and developments of the system will shortly take place.

---

**Electric and General Investment Company.**—Subject to audit, the directors have decided to recommend the payment of the following dividends, &c., for the year ended May 31st, 1901:—Ordinary shares.—A dividend of 5s. per share, of which 2s. per share was paid on account in December last, leaving 3s. per share to be distributed, and a bonus of 2s. per share, making together a present distribution of 5s. per share, or 25 per cent., or a total distribution of 7s. per share, or 35 per cent., for the year. Founders' shares.—A dividend for the year ended May 31st of £50 per share.

**Stock Exchange Notices.**—The Committee has appointed a special settling day as under:—June 19th, British Electric Traction Company, Limited—Further issue of 30,000 6 per cent. cumulative preference shares of £10 each (issued at £1 10s. premium), £7 10s. paid (of which £6 is capital and £1 10s. premium), Nos. 160,001 to 190,000; and has ordered the undermentioned to be quoted in the Official List:—British Electric Traction Company, Limited—Further issue of 2,074 ordinary shares of £10 each, fully paid, Nos. 120,001 to 122,074.

**Siemens Bros., Limited.**—The ordinary general meeting of the shareholders of this company was held on 30th ult. at the offices, 12, Queen Anne's Gate, Westminster, S.W. The representative of the ELECTRICAL REVIEW attended, and was informed the proceedings were strictly private, and a request for a copy of the annual report was refused.

**City of London Electric Lighting Company.**—The following are particulars of the revenue of this company for the past March quarter:—Sale of current, &c., £91,611 12s. 7d.; working expenses, £45,728 1s. 5d.; leaving available for interest on debenture stocks and loans, depreciation, special charges and dividends, £45,883 11s. 2d.

**The Charing Cross and Strand Electricity Supply Corporation.**—At an extraordinary meeting held on 31st ult., a resolution was passed authorising the directors to raise or borrow such sums as were necessary, to the maximum of £500,000, for the purposes of the corporation's City undertaking.

**The Telegraph Manufacturing Company.**—The annual meeting of this company is to be held at Liverpool to-day.

---

## TRAFFIC RECEIPTS.

Birkenhead Corporation Trams.—The returns for the four weeks ending May 19th show that the mileage of the Birkenhead electric cars was 18,519 miles. 156,563 penny tickets were sold, and 33,240 tickets at 2d. The number of passengers carried was 189,803, and the total receipts £929.

**Blackburn Corporation Tramways.—The receipts for the week ending May 31st were £663; corresponding week last year, £452; increase, £211. Total to date, £10,031; corresponding period last year, £8,843; increase, £1,188. Miles of track open, 8½.**

**Blackpool and Fleetwood Tramways.—The receipts for the week ending June 1st were £1,863; corresponding week last year, £371; increase, £1,492. Total to date, £6,993; corresponding period last year, £5,895; increase, £1,098.**

**Bristol Tramways and Carriage Company.—The receipts for the week ending May 31st were £6 597; corresponding period last year, £3,046; increase, £3,550. Passengers carried during week, 1,218,784.**

**Central London Railway.—The receipts for the week ending June 1st were £6,368; previous week, £6,165; increase, £203. Total receipts to date (22 weeks), £136,468. Miles open, 6.**

**City and South London Railway.—The receipts for the week ending June 2nd were £1,815; corresponding week last year, £1,434; increase (Moorgate extension open) £381. Total to date, £43,286; corresponding period last year, £27,754; increase, £15,532. Miles open, 1901, 4½; 1900, 3½.**

**Dover Corporation Tramways.—The receipts for the week ending May 25th were £204 15s. 4½d.; corresponding week last year, £207 17s. 1d.; decrease, £3 1s. 8½d. Week ending June 1st, £289 9s. 3½d.; corresponding week last year, £207 17s. 1d.; decrease, £3 1s. 8½d. Total to date, £3,661 0s. 3d.; corresponding period last year, £3,403 4s. 6d.; increase, £258 15s. 9d. Miles of track open, 8; Car miles run, 1901, 5,194; 1900, 4,949. Number of cars, 11.**

**Dublin United Tramways Company.—The receipts for the week ending May 31st were as follows:—D. U. T. Co., electric cars, £4,108 13s. 4d.; D. S. D. Co., electric cars, £1,011 2s. 5d.; total £5,119 15s. 9d.; corresponding week last year—D. U. T. Co., electric cars, £3,412 11s. 3d.; ditto, horse cars, £54 5s. 7d.; D. S. D. Co., electric cars, £857 0s. 8d.; total, £4,323 17s. 6d.; increase, £795 18s. 3d.; aggregate to date, £88,478 11s. 8d.; aggregate to date last year, £88,379 16s. 3d.; increase, £98 15s. 5d. The mileage worked is 45 miles electrically, as against 42 miles electrically, and 2 miles by horses, for the corresponding period last year. 1901, Whitsuntide.**

Glasgow Corporation Tramways.—The receipts for the week ending May 25th were £11,835 11s. 6d., compared with £9,623 10s. 4d. for the same period last year. The drawings for the year amounted to £484,870, as compared with £449,090 for the year 1899—1900.

Liverpool Corporation Trams.—Revenue for the fortnight ended May 25th was £18,873 6s., or £2,706 13s. 7d. more than in the corresponding fortnight of last year. 4,076,137 passengers were carried, an increase of 1,008,024.

**Liverpool Overhead Railway.—The receipts for the week ending June 2nd were £2,079; corresponding week last year, £1,352; increase, £727. 1901 includes Bank Holiday. Total to date, £34,455; corresponding period last year, £31,009; increase, £3,446. Miles open, 6 miles 57 chains.**

## STOCKS AND SHARES.

Wednesday Evening.

WITH the more cheerful aspect developed this week by the consol market has come a generally better tone throughout other investment departments, home rails alone excepted. There is a growing ease in the money market which makes for higher prices in the Stock Exchange, and which, had it but a little business to back it, would soon exercise an appreciable effect upon quotations. Our telegraph list this week shows that the public are on the look-out for cheap stock: there are six rises against one fall. The electricity supply section is almost neutral so far as changes go. National Telephones are losing part of the improvement that they gained last week.

Two important new companies claim first attention. Of Thornycroft's we spoke a fortnight ago, before the company came out. The Ordinary shares are being now dealt in at 10s. premium, while the Preference are $\frac{1}{16}$ to $\frac{3}{16}$ premium. A story is circulating to the effect that the Ordinary are to be made the subject of a "corner," and the price put much higher. Market-manipulators, we may observe, would not tell such a thing as this as to all and sundry; the rumour looks absurdly improbable on the face of it. The second new emission is that of Messrs. Drake & Gorham, Limited, the well-known electrical engineers. The purchase price is £106,000, and the vendors take 44,000 shares in part payment, the rest in cash. Dividends of 8 per cent. are anticipated, provided the profits are maintained, and the shares appear to be a fair business speculation. A nominal premium is quoted on the shares.

No difference has been made to electrical railway shares by the severe depression suffered by the rest of home railway stocks owing to anticipations of lowered dividends in August. All the "Tube" varieties are maintained at previous prices. Great Northern and City "A" Preferred Ordinary are called 8 to 10 for the fully-paid £10 shares. The nominal price of Baker Street and Waterloo Ordinary is 70s. discount. This luckless undertaking is, of course, mainly owned by the London and Globe Corporation, which is still seeking to dispose of its interests in the railway for a quarter of a million sterling. If it succeeds, it will mean that the Corporation—its shareholders, that is—drops £450,000 over this awful white elephant.

The telegraph market displays a rise in all the Anglo-American Company's stocks. In fact, there was quite a little boom in them at the end of last week, the buying being induced by the substantially better position of the American railroad market. Some recession from the best prices attained has since taken place, but the Ordinary and Preferred are both a point up, and the Deferred is also higher. The demand for Anglo stocks spread to Direct United States, it being pointed out that the boom in Yankees is apparently still boiling, and that the "wire" companies must be benefitting largely. Globe Telegraph Ordinary show a 5s. rise, bringing them up to par, and Eastern Extensions are better to the same extent. Great Northern has moved down £1, but another remarkable spurt in Amazon Debentures took the price up 5 per cent. The shares are quoted at £4 middle.

Electricity Supply shares continue in good request. County of London Ordinary are ½ better upon good buying this week. Metropolitans are steadily regaining their lost ground, and are now £4 10s. above the worst price they recently touched. The new are valued equally with the old. Kensington and Knightsbridge Ordinary are being wanted, and exhibit half a sovereign rise. The 4 per cent. Debenture stock of Kensington and Knightsbridge and Notting Hill is 102 to 104.

After this little flirtation with electric traction between Earl's Court and High Street, Kensington, the Metropolitan District Railway directors are now seriously considering the financial part of the proposed scheme for electrifying the whole line. A new undertaking is suggested, to be known as the Metropolitan District Electric Traction Company, which will do the work for a stated sum. Such, at least, is the present idea; whether it will come to fruition or not this week ought to finally show. District stock is harder on the approaching leap in the dark, but Metropolitan is decidedly weak, perhaps because there is no inner circle to keep the price moving, as in the case of its unfortunate brother.

National Telephone shares, as we have said, are lower, and it is now reported that the Government negotiations have been broken off. United River Plate shares have found supporters, and are better at 5¼ middle.

In the miscellaneous section Reuters are 6s. easier, allowing for the deduction of a 4s. dividend. British Westinghouse Preference are steady at 5, but there is naturally a lack of premium on the new issue, which is made at the same price as that ruling for the old.

## SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

| Present Issue. | NAME. | Stock or Share. ‡ | Dividends for the last three years. 1898. | 1899. | 1900. | Closing Quotation May 29th. | Closing Quotations June 5th. | Business done during week ended June 5th, 1901. Highest. | Lowest |
|---|---|---|---|---|---|---|---|---|---|
| 96,900 | African Direct Telegraph, 4 % Debs ... ... ... | 100 | ... | ... | ... | 100 —103 | 100 —103 | ... | ... |
| 119,700£ | Amazon Telegraph 5 % Debs., Nos. 1 to 1,250 Red. ... | 100 | ... | ... | ... | 73 — 78 | 78 — 83 | ... | ... |
| 822,700£ | Anglo-American Telegraph ... ... ... ... ... | Stock | £3 9s. | 73/6 | 3½% | 53 — 56 | 54 — 57 | 53 | ... |
| 3,088,540£ | Do. do. 6 % Pref ... ... ... | Stock | 6 % | 6 % | 6 % | 97 — 39 | 98 —100 | 99⅜ | 99 |
| 3,088,540£ | Do. do. Deferred ... ... ... | Stock | 18s. % | £1 7s. | 5s.% | 10 — 10½ | 10½ — 11 | 11 3/16 | 10 13/16 |
| 44,000 | Chili Telephone, Nos. 1 to 44,000 ... ... ... ... | 5 | 3 % | 4 % | ... | 3½ — 4 | 3½ — 4 | ... | ... |
| 13,333,300$ | Commercial Cable ... ... ... ... ... ... | $100 | 8 % | 8 % | ... | 175 —185 | 175 —185 | ... | ... |
| 1,589,496£ | Do. do. Sterling 500 year 4 % Deb. Stock Red. | Stock | ... | ... | ... | 100 —102 | 100 —102 | ... | ... |
| 16,000 | Cuba Telegraph ... ... ... ... ... ... | 10 | 8 % | 7 % | ... | 7 — 8 | 7 — 8 | ... | ... |
| 6,000 | Do. 10 % Pref. ... ... ... ... ... | 10 | 10 % | ... | ... | 15 — 16 | 15 — 16 | ... | ... |
| 12,931 | Direct Spanish Telegraph ... ... ... ... | 5 | 4 % | 4 % | 4 % | 3 — 4 | 3 — 4 | ... | ... |
| 6,000 | Do. do. 10 % Cum. Pref. ... ... ... | 5 | ... | ... | ... | 9 — 10 | 9 — 10 | ... | ... |
| 30,000£ | Do. do. 4½ % Debs. ... ... ... | 50 | ... | ... | ... | 100 —104% | 100 — 104% | ... | ... |
| 60,710£ | Direct United States Cable ... ... ... ... | 20 | 3½% | 3 % | 3 % | 10 — 10½ | 10½ — 10⅝ | 10 11/16 | ... |
| 108,300£ | Direct West India Cable, 4½ % Reg. Deb. ... ... | 100 | ... | ... | ... | 100 —103 | 100 —103 | ... | ... |
| 4,000,000 | Eastern Telegraph, Ord. Stock ... ... ... ... | Stock | 7 % | 7 % | ... | 140 —145 | 140 —145 | 142 | 141½ |
| 1,826,888 | Do. 3½ % Pref. Stock ... ... ... | 100 | ... | ... | ... | 91 — 94 | 91 — 94 | 91½ | ... |
| 1,432,268£ | Do. 4 % Mort. Deb. Stock Red. ... | Stock | ... | ... | ... | 110 —114 | 110 —114 | 111½ | ... |
| 303,000 | Eastern Extension, Australasia, and China Telegraph ... | 10 | 7 % | 7 % | 7 % | 13½ — 14 | 13¾ — 14½ | 14⅝ | 13¾ |
| 320,000£ | Do. 4 % Deb. Stock ... ... ... ... ... | Stock | ... | ... | ... | 111 —116 | 111 —116 | ... | ... |
| 300,000£ | Eastern and South African Telegraph, 4 % Mort. Deb. Nos. 1 to 3,000, red. 1909 | 100 | ... | ... | ... | 100 —103 | 100 —103 | 100½ | ... |
| 200,000£ | Do. 4 % Reg. Mt. Debs. (Mauritius Sub.) 1—8,000 | 25 | ... | ... | ... | 100 —103% | 100 —103 | ... | ... |
| 180,227 | Globe Telegraph and Trust ... ... ... ... | 10 | 5½% | 5¼% | ... | 9½ — 10 | 9⅞ — 10½ | 10 1/16 | 9⅞ |
| 180,042 | Do. do. 6 % Pref. ... ... ... | 10 | 6 % | ... | ... | 14⅜ — 15½ | 14⅜ — 15½ | 15 | 14⅜ |
| 150,000 | Great Northern Telegraph, of Copenhagen ... ... | 10 | 12½% | ... | 15 % | 32 — 34 | 31 — 33 | ... | ... |
| 82,000£ | Halifax and Bermuda Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red. | 100 | ... | ... | ... | 100 —103 | 100 —103 | ... | ... |
| 17,000 | Indo-European Telegraph ... ... ... ... ... | 25 | 10 % | 10 % | 10 % | 43 — 47 | 43 — 47 | ... | ... |
| 100,000£ | London Platino-Brazilian Telegraph, 6 % Debs. ... ... | 100 | ... | ... | ... | 103 —106 | 103 —106 | ... | ... |
| 72,680 | Montevideo Telephone, Limited, Ord., Nos. 1 to 72,680 ... | 1 | ... | 2½% | ... | ¼ — ⅜ | ¼ — ⅜ | ... | ... |
| 86,492 | Do. do. do. 5 % Pref., Nos. 1 to 86,492 | 1 | 4 % | 5 % | ... | ⅝ — 1 | ⅝ — 1 | ... | ... |
| 590,000 | National Telephone, 1 to 590,000 ... ... ... ... | 5 | 6 % | 5 % | 5 % | 3⅜ — 4 | 3⅜ — 3⅝ | 3½ | 3⅜ |
| 15,000 | Do. 6 % Cum. 1st Pref. ... ... ... | 10 | 6 % | 6 % | 6 % | 11½ — 12½ | 11½ — 12½ | 12½ | ... |
| 15,000 | Do. 6 % Cum. 2nd Pref. ... ... ... | 10 | 6 % | 6 % | 6 % | 11½ — 12½ | 11½ — 12½ | ... | ... |
| 250,000 | Do. 5 % Non-cum. 3rd Pref., 1 to 250,000 | 5 | 5 % | 5 % | 5 % | 4⅜ — 4⅝ | 4¼ — 4½ | 4 7/16 | ... |
| 2,000,000£ | Do. 3½ % Deb. Stock Red. ... ... | Stock | 3½% | 3½% | 3½% | 87 — 90 | 87 — 90 | 89 | ... |
| 500,000£ | Do. 4 % Deb. Stock Red. ... ... ... | 100 | ... | ... | 4 % | 95 — 98 | 95 — 98 | 96 | 95⅛ |
| 171,504 | Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid | 1 | 5 % | 5 % | 6 % | ⅞ — 1 | ⅞ — 1 | ... | ... |
| 100,000£ | Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 ... | 100 | ... | ... | ... | 100 —103 | 100 —103 | ... | ... |
| 11,839 | Reuter's ... ... ... ... ... ... ... ... | 8 | 5 % | 5 % | 5 % | 7½ — 8½ | 7 — 8 xd | 7⅝ | ... |
| 3,381 | Submarine Cables Trust ... ... ... ... ... | Cert. | ... | ... | ... | 125 —130 | 125 —130 | ... | ... |
| 58,000 | United River Plate Telephone ... ... ... ... | 5 | 6 % | 7 % | ... | 4½ — 5 | 5 — 5½ | 5 | ... |
| 40,000 | Do. do. 5 % Cum. pref. Nos. 1—40,000 | 5 | ... | ... | ... | 4⅝ — 5¼ | 4⅝ — 5¼ | ... | ... |
| 179,947£ | Do. do. 5 % Debs. ... ... ... | Stock | ... | ... | ... | 103 —106 | 103 —106 | ... | ... |
| 171,000 | West African Telegraph, 5 % Debs.... ... ... ... | 100 | ... | ... | ... | 98 —101 | 98 —101 | ... | ... |
| 30,008 | West Coast of America, Nos. 1—30,000 and 53,001—53,008 | 2½ | ... | ... | ... | ¼ — ⅜ | ¼ — ⅜ | ¼ | ... |
| 150,000£ | Do. do. 4 % Debs., 1—1,500 gua. by Braz. Sub. Tel. | 100 | ... | ... | ... | 100 —103 | 100 —103 | ... | ... |
| 207,930 | Western Telegraph, Ltd., Nos. 1—207,930 ... ... ... | 10 | 7 % | 7 % | ... | 13⅜—14½ | 13⅜ — 14½ | 14 | 13 13/16 |
| 75,000£ | Do do. 5 % Debs. 2nd series, 1906 ... | 100 | ... | ... | ... | 102 —105 | 102 —105 | ... | ... |
| 348,777£ | Do. do. 4 % Deb. Stock Red. ... ... | 100 | ... | ... | ... | 102 —105 | 102 —105 | ... | ... |
| 88,321 | West India and Panama Telegraph ... ... ... ... | 10 | 2 % | 5% | ... | ⅜ — ⅝ | ⅜ — ⅝ | ... | ... |
| 34,563 | Do. do. do. 6 % Cum. 1st Pref. ... | 10 | ... | ... | ... | 5 — 6 | 5 — 6 | ... | ... |
| 4,669 | Do. do. do. 6 % Cum. 2nd Pref. ... | 10 | ... | ... | ... | 3 — 5 | 3 — 5 | ... | ... |
| 80,000£ | Do. do. do. 5 % Debs., Nos. 1 to 1,800 | 100 | ... | ... | ... | 103 —106 | 103 —106 | ... | ... |

## ELECTRICITY SUPPLY COMPANIES.

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 19,661 | Brompton & Kensington Elec. Lt. Sup., Ord., 101 to 19,761 | 5 | 6 % | 6 % | 6 % | 7⅞ — 8¼ | 7⅞ — 8¼ | ... | ... |
| 12,000 | Do. do. 7 % Cum. Pref.... | 5 | ... | ... | ... | 8½ — 9 | 8½ — 9 | ... | ... |
| 50,000 | Charing Cross and Strand Electricity Supply ... ... | 5 | 8 % | 9 % | 9 % | 9 — 10 | 9 — 10 | ... | ... |
| 20,000 | Do. do. do. do. 4½% Cum. Pref. | 5 | ... | ... | ... | 5¼ — 5⅝ | 5¼ — 5⅝ | 5⅝ | ... |
| 34,000 | *Chelsea Electricity Supply, Ord. ... ... ... ... | 5 | 6 % | 6 % | 5½% | 6 — 6½ | 6 — 6½ | 6½ | ... |
| 150,000£ | Do. do. do. % Deb. Stock Red. ... | Stock | ... | ... | ... | 109 —112 | 109 —112 | ... | ... |
| 70,579 | City of London Electric Lighting, Ord. 40,001—110,579... | 10 | 6 % | 4 % | 0 % | 8½ — 9⅛ | 8½ — 9⅛ | 8⅝ | ... |
| 40,000 | Do. 6 % Cum. Pref., 1 to 40,000 ... ... ... | 10 | 6 % | 6 % | 6 % | 12 — 13 | 12 — 13 | ... | ... |
| 400,000£ | Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid | ... | ... | ... | ... | 122 —127 | 122 —127 | ... | ... |
| 40,000 | County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000 | 10 | nil | 4 % | 4 % | 8 — 9 xd | 8½ — 9½ | ... | ... |
| 20,000 | Do. do. do. 6 % Pref., 40,001—60,000 | 10 | 6 % | 6 % | 6 % | 11½ — 12½ | 11½ — 12½ | ... | ... |
| 200,000£ | Do. 4½ % Deb. Stock, Prov. Certs (all paid) Rd. ... | ... | ... | ... | ... | 105 —108 | 105 —108 | 106½ | ... |
| 35,500 | Edmundson's Elec. Corp., Ord. Shares ... ... ... | 5 | 7 % | ... | ... | 5½ — 5⅝ | 5½ — 5⅝ | 5⅝ | ... |
| 13,363 | Do. do. 6 % Cum. Pref. ... ... | ... | ... | ... | ... | 5½ — 6 | 5½ — 6 | 5⅝ | ... |
| 75,000£ | Do. do. 4½ % 1st Mort. Deb. Stock. ... | 100 | ... | ... | ... | 104 —107 | 104 —107 | 106 | ... |
| 21,000 | Kensington and Knightsbridge Electric, Ord. ... ... | 5 | ... | ... | ... | 11 — 12 | 11½ — 12½ | 12 | 11⅝ |
| 90,000 | Do. do. do. 4 % Deb. Stock | Stock | ... | ... | ... | 102 —105 | 102 — 104 | ... | ... |
| 110,000 | London Electric Supply Corporation, Limited, Ord. ... | 3 | ... | ... | ... | 1¼ — 1⅝ | 1¼ — 1⅝ | ... | ... |
| 49,840 | Do. do. do. do. 6 % Pref. | 5 | 6 % | ... | ... | 4 — 5 | 4 — 5 | ... | ... |
| 250,000£ | Do. do. do. 4% 1st Mt. Db. Stock Rd. | Stock | ... | ... | ... | 98 —101 | 98 —101 | ... | ... |
| 85,000 | Metropolitan Electric Supply, 101 to 62,500 ... ... | 10 | 5 % | 5 % | 6 % | 13⅜ — 14½ | 14 — 15 | 14½ | 14 |
| 220,000£ | Do. 4½% First Mortgage Debenture Stock | ... | ... | ... | ... | 110 —113 | 110 —113 | 111 | ... |
| 250,000£ | Do. 3½% Mort. Deb. Stock Red. ... ... | Stock | ... | ... | ... | 96 — 99 | 96 — 99 | ... | ... |
| 6,452 | Notting Hill Electric Lighting ... ... ... ... | 10 | 6 % | 7 % | 7 % | 15½— 16½ | 15½— 16½ | ... | ... |
| 40,000 | St. James's and Pall Mall Electric Light, Ord. ... ... | 5 | 14½% | 14½% | 14½% | 15 — 16 | 15 — 16 | 15⅝ | ... |
| 20,000 | Do. do. 7 % Pref., 20,081 to 40,080 | 5 | 7 % | 7 % | 7 % | 8½— 9½ | 8½— 9½ | ... | ... |
| 150,000£ | Do. do. 3½ % Deb. Stock Red. ... | 100 | ... | ... | ... | 98 —101 | 98 —101 | ... | ... |
| 12,000 | Smithfield Market Elect. Supply, Ord. ... ... ... | 5 | ... | ... | ... | 2 — 2½ | 2 — 2½ | ... | ... |
| 50,000£ | Do. do. 4 % Deb. ... ... | 100 | ... | ... | ... | 80 — 90 | 80 — 90 | ... | ... |
| 65,000 | South London Electricity Supply, Ord. ... ... ... | 5 | ... | ... | ... | 2½— 3½ | 2½— 3½ | ... | ... |
| 79,900 | Westminster Electric Supply, Ord., 101 to 80,000... ... | 5 | 12 % | 13 % | 10½% | 12 — 13 | 12 — 13 | 12⅝ | ... |

* Subject to Founders Shares.
Unless otherwise stated all shares are fully paid.
Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

Quotations on Liverpool Stock Exchange.
‡ Dividends paid in deferred share warrants, profits being used as capital.

## SHARE LIST OF ELECTRICAL COMPANIES.—*Continued.*

### ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

| Present Issue. | NAME. | Stock or Share. | Dividends for the last three years. | | | Closing Quotation May 29th. | Closing Quotation June 5th. | Business done week ended June 5th, 1901. | |
|---|---|---|---|---|---|---|---|---|---|
| | | ‡ | 1898. | 1899. | 1900. | | | Highest | Lowest |
| 20,000 | British Aluminium 7 % Cum. Pref. ... ... ... ... | 10 | ... | ... | ... | 7½ — 8½ | 7½ — 8½ | ... | ... |
| 300,000*l* | Do. do. 5 % 1st Mort. Deb. Stock Red. ... | Stock | ... | ... | ... | 89 — 93 | 85 — 93 | ... | ... |
| 45,000 | British Electric Traction ... ... ... ... ... | 10 | 6 % | ... | ... | 14½ — 15½ | 14½ — 15½ | 15½ | 15 |
| 50,000 | Do. do. 6 % Cum. Pref. ... ... ... | 10 | ... | ... | ... | 12 — 13 | 12 — 13 | ... | ... |
| 350,000*l* | Do. do. 5 % Perpetual Debenture Stock ... | Stock | ... | ... | ... | 120 —123 | 120 —123 | ... | ... |
| 70,000 | British Insulated Wire Ord. ... ... ... ... ... | 5 | 15 % | 20 % | 15 % | 10 — 11 | 10 — 11 | ... | ... |
| 70,000 | Do. do. 6 % Cum. Pref. ... ... ... | 5 | ... | ... | ... | 5⅝ — 6½ | 5⅝ — 6½ | ... | ... |
| 90,000 | Brush Elecl. Enging., Ord., 1 to 90,000 ... ... | 2 | 5 % | 6 % | ... | 1⅝ — 1⅞xd | 1⅝ — 1⅞ | ... | ... |
| 90,000 | Do. do. Non-cum. 6 % Pref., 1 to 90,000 ... | 2 | 6 % | 6 % | ... | 2⅛ — 2⅜ | 2⅛ — 2⅜ | ... | ... |
| 125,000*l* | Do. do. 4½ % Perp. Deb. Stock ... ... | Stock | ... | ... | ... | 103 —108 | 103 —108 | ... | ... |
| 108,710*l* | Do. do. 4½ % Perp. 2nd Deb. Stock ... | Stock | ... | ... | ... | 101 —104 | 101 —104 | ... | ... |
| 30,000 | Callender's Cable Construction shares, Nos. 1—30,000 ... | 5 | 15 % | 15 % | 15 % | 14½ — 15½ | 14½ — 15 | 15 | ... |
| 40,000 | Do. do. 5 % Cum. Pref. ... ... ... | 5 | ... | ... | ... | 5½ — 6 | 5½ — 6 | ... | ... |
| 90,000*l* | Do. do. 4½ % 1st Mort. Deb. Stock Red ... | Stock | ... | ... | ... | 109 —113 | 109 —113 | ... | ... |
| 206,297 | Central London Railway, Ord. Shares ... ... ... | 10 | ... | ... | ... | 9½ — 10 | 9½ — 10 | ... | ... |
| 78,703 | Do. do. Pref. half-shares ... ... ... | 5 | ... | ... | ... | 4½ — 5 | 4½ — 5 | ... | ... |
| 78,703 | Do. do. Def. do. ... ... ... | 5 | ... | ... | ... | 4⅝ — 5½ | 4⅝ — 5½ | ... | ... |
| 855,000 | City and South London Railway ... ... ... ... | Stock | 2⅛% | 1⅞% | 1½% | 51 — 53 | 51 — 53 | ... | ... |
| 37,500 | Do. do. Ord. shares Nos. 22,501 to 60,000 ... ... | 10 | ... | ... | ... | 4⅜ — 5½ | 5 — 5½ | ... | ... |
| 54,000 | Crompton & Co., Nos. 1 to 54,000 ... ... ... ... | 3 | 6 % | 7½% | ... | 3½ — 4 | 3½ — 4 | ... | ... |
| 100,000*l* | Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 red | ... | ... | ... | ... | 101 —104 | 101 —104 | ... | ... |
| 99,261 | Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261 | 5 | 6 % | 6 % | ... | 1 — 1½ | 1 — 1½ | ... | ... |
| 17,139 | Do. do. do. "A" Shares, 01—017,139 ... | 5 | 6 % | 6 % | ... | 2½ — 3½ | 2½ — 3½ | ... | ... |
| 344,023*l* | Do. do. do. 4 % Deb. Stock Red ... | 100 | ... | ... | ... | 87 — 89 | 87 — 89 | ... | ... |
| 100,000*l* | Do. do. 5% 2nd Deb. Stock Prov. Certs. all pd. | 100 | ... | ... | ... | 94 — 98 | 94 — 98 | ... | ... |
| 112,100 | Electric Construction, 1 to 112,100 ... ... ... ... | 2 | 6 % | 6 % | ... | 1⅞ — 2¼ | 1⅞ — 2¼ | ... | ... |
| 25,000 | Do. do. 7 % Cum. Pref., 1 to 25,000... ... | 2 | 7 % | ... | ... | 2⅛ — 3 | 2⅛ — 3 | ... | ... |
| 182,500*l* | Do. do. 4 % Perp. 1st Mort. Deb. Stock ... | Stock | ... | ... | ... | 101 —104 | 101 —104 | 100 | ... |
| 35,000 | Henley's (W. T.) Telegraph Works, Ord. ... ... ... | 5 | 14 % | 15 % | 20 % | 15½ — 16½ | 15½ — 16½ | ... | ... |
| 35,000 | Do. do. do. 4½ % Pref. ... ... | 5 | ... | 4½% | 4½% | 5½ — 6 | 5½ — 6 | ... | ... |
| 50,000*l* | Do. do. do. 4½ Mort. Deb. Stock... | Stock | ... | ... | ... | 107 —111 | 107 —111 | ... | ... |
| 50,000 | India-Rubber, Gutta-Percha and Telegraph Works ... | 10 | 10 % | 10 % | ... | 21 — 22 | 21 — 22 | ... | ... |
| 300,000*l* | Do. do. do. 4 % 1st Mort. Deb ... ... | 100 | ... | ... | ... | 101 —104 | 101 —104 | ... | ... |
| 37,500 | †Liverpool Overhead Railway, Ord. ... ... ... | 10 | 3½% | 3¾% | 3½% | 8⅛ — 8½ | 8⅛ — 8½ | ... | ... |
| 10,000 | † Do. do. Pref., £10 paid ... ... | 10 | 5 % | 5 | ... | 13 — 13½ | 13 — 13½ | ... | ... |
| | §Rosling, Appleby & Fynn 6 % Cum. Pref. ... ... ... | £1 | ... | ... | 6 % | 19/- to 20/- | ... — ... | ... | ... |
| 37,350 | Telegraph Construction and Maintenance ... ... ... | 12 | 15 % | 15 % | 17½% | 35 — 39 | 35 — 39 | ... | ... |
| 150,000*l* | Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ... | 100 | ... | ... | ... | 102 —105 | 102 —105 | ... | ... |
| 20,000 | Telegraph Manufacturing, Ord. Nos. 1 to 20,000 ... ... | 5 | 8 % | 12 % | 12 % | 10½ — 11½ | 10½ — 11½ | ... | ... |
| 20,000 | Do. do. 5 % Cm. Prf. Nos. 1 to 20,000... | 5 | ... | ... | ... | 5½ — 6 | 5½ — 6 | ... | ... |
| 540,000*l* | Waterloo and City Railway, Ord. Stock ... ... ... | 100 | 3 % | 3 % | 3 % | 93 — 96 | 94 — 97 | 93½ | ... |

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. § From Bradford Share List.

### LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

Consolidated Telephone Construction and Maintenance, ⅛—⅜
National Electric Free Wiring, 12/6 paid, ½—¾.

Oldham, Ashton, and Hyde Electric (£10 pd.), Ord., 16—17.
Do. do. Pref. (£10 pd.), 10—10½.
*T. Parker, £10 (fully paid), 16½.

* From Birmingham Share List.

Bank rate of discount 4 per cent. (February 21st, 1901).

## MARKET QUOTATIONS, Wednesday, June 5th.

| CHEMICALS, &c. | | This week. | Last week. | Inc. or Dec. |
|---|---|---|---|---|
| *a* Acid, Hydrochloric .. .. | per cwt. | 5/- | 5/- | .. |
| *a* ,, Nitric .. .. .. | per cwt. | 22/- | 22/- | .. |
| *a* ,, Oxalic .. .. .. | per cwt. | 32/- | 32/- | .. |
| *a* ,, Sulphuric .. .. .. | per cwt. | 5/6 | 5/6 | .. |
| *a* Ammoniac, Sal .. .. .. | per cwt. | 89/- | 89/- | .. |
| *a* Ammonia, Muriate (crystal) .. | per ton | £33 10 | £33 10 | .. |
| *a* ,, ,, .. | per ton | £30 | £30 | .. |
| *a* Bleaching powder .. .. | per ton | £7 | £7 | .. |
| *a* Bisulphide of Carbon .. .. | per ton | £15 | £15 | .. |
| *a* Borax .. .. .. .. | per ton | £17 10 | £17 10 | .. |
| *a* Benzole (90 %) .. .. .. | per gal. | 7/- | 7/- | .. |
| *a* ,, (50/90%) .. .. .. | per gal. | 5/6 | 5/6 | .. |
| *a* Copper Sulphate .. .. | per ton | £23 | £23 | .. |
| *a* Lead, Nitrate .. .. .. | per ton | £24 | £24 | .. |
| *a* ,, White Sugar .. .. | per ton | £31 | £31 | .. |
| *a* ,, Peroxide .. .. .. | per ton | £27 10 | £27 10 | .. |
| *a* Methylated Spirit .. .. | per gal. | 2/6 | 2/6 | .. |
| *a* Naphtha, Solvent (90% at 160° C). | per gal. | 5/6 | 5/6 | .. |
| *a* Potash, Bichromate, in casks.. | per lb. | 3½d. | 3½d. | .. |
| *a* ,, Caustic (75/80%) .. | per ton | £24 | £24 | .. |
| *a* ,, Bisulphate .. .. | per ton | £35 | £35 | .. |
| *a* Shellac .. .. .. .. | per cwt. | 61/- | 61/- | .. |
| *a* Sulphate of Magnesia .. .. | per ton | £4 10 | £4 10 | .. |
| *a* Sulphur, Sublimed Flowers .. | per ton | £6 5s. | £6 | .. |
| *a* ,, Recovered .. .. | per ton | £5 10 | £5 10 | .. |
| *a* ,, Lump .. .. .. | per ton | £5 | £5 | .. |
| *a* Soda, Caustic (white 70 %) .. | per ton | £10 15 | £10 15 | .. |
| *a* ,, Crystals .. .. .. | per ton | £3 | £3 | .. |
| ,, Bichromate, casks .. | per lb. | 2¾d. | 2¾d. | .. |
| **METALS, &c.** | | | | |
| *b* Aluminium Wire, in ton lots.. | per ton | £224 | £224 | .. |
| *b* ,, Sheet, in ton lots | per ton | £191 | £191 | .. |
| *p* Babbitt's metal ingots.. .. | per ton | £75 to £140 | £75 to £140 | .. |
| *c* Brass (rolled metal 2" to 12") basis | per lb. | 7½d. | 7½d. | .. |
| *c* ,, Tube (brazed) .. .. | per lb. | 10d. | 10d. | .. |
| *c* ,, ,, (solid drawn) .. | per lb. | 8½d. | 8½d. | .. |
| *c* ,, Wire, basis .. .. | per lb. | 8d. | 8d. | .. |
| *c* Copper Tubes (brazed) .. | per lb. | 11d. | 11d. | .. |
| *c* ,, ,, (solid drawn) .. | per lb. | 10¾d. | 10¾d. | .. |
| *g* Copper Bars (best selected) .. | per ton | £85 | £85 | .. |

| METALS, &c *(continued.)* | | This week. | Last week. | Inc. or Dec. |
|---|---|---|---|---|
| *g* Copper Sheet .. .. .. | per ton | £85 | £85 | .. |
| *g* ,, Rod .. .. .. | per ton | £85 | £85 | .. |
| *c* ,, (Electrolytic) Bars .. | per ton | £82 | £83 | .. |
| *c* ,, ,, Sheets .. | per ton | £90 | £90 | .. |
| *c* ,, ,, Rod .. | per ton | £84 | £84 | .. |
| *c* ,, ,, H.C. Wire | per lb. | 9¾d. | 9¾d. | .. |
| *f* Ebonite Rod .. .. .. .. | per lb. | 8/- | 8/- | .. |
| *f* ,, Sheet .. .. .. | per lb. | 5/- | 5/- | .. |
| *n* German Silver Wire .. .. | per lb. | 1/5 | 1/5 | .. |
| *h* Gutta-percha fine .. .. | per lb. | 8/- | 8/- | .. |
| *h* India-rubber, Para fine .. .. | per lb. | 3/9 to 3/10 | 3/9½ to 3/10½ | ½d. dec. |
| *i* Iron, Charcoal Sheets .. .. | per ton | £18 | £18 | .. |
| *i* ,, Pig (Cleveland warrants) .. | per ton | 45/6½ | 45/8 | 1½d. dec. |
| *i* ,, Forgings, according to size | per ton | From £11 | From £11 | .. |
| *i* ,, Scrap, heavy .. .. | per ton | 70/- to 72/6 | 70/- to 72/6 | .. |
| *i* ,, Wire, galvanised No. 8 .. | per ton | £10 5 | £10 5 | .. |
| *g* Lead, English Ingot .. .. | per ton | £12 10 to £12 12 6 | £12 10 to £12 12 6 | .. |
| *g* ,, ,, Sheet .. .. | per ton | £13 10 | £13 10 | .. |
| *m* Manganin Wire No. 28 .. .. | per lb. | 8/- | 8/- | .. |
| *g* Mercury .. .. .. .. | per bot. | £9 2 6 | £9 2 6 | .. |
| *d* Mica (in original cases), small .. | per lb. | 3d. to 9d. | 3d. to 9d. | .. |
| *d* ,, ,, ,, medium | per lb. | 1/9 to 2/9 | 1/9 to 2/9 | .. |
| *d* ,, ,, ,, large .. | per lb. | 3/8 to 7/8 | 3/8 to 7/8 | .. |
| *p* Phosphor Bronze, plain castings | per lb. | 1/0½ to 1/8 | 1/0½ to 1/8 | .. |
| *p* ,, rolled bars & rods | per lb. | 1/1 to 1/4 | 1/1 to 1/4 | .. |
| *p* ,, ,, strip & sheet | per lb. | From 1/8 | From 1/8 | .. |
| *o* Platinum .. .. .. .. | per oz. | £4 1 | £4 1 | .. |
| *p* Silicium Bronze Wire .. .. | per lb. | 10½d. to 1/0½ | 10½d. to 1/0½ | .. |
| *i* Steel, Magnet, acc'd'ng to desc'p'n | per ton | From £15 to £40 | | .. |
| *i* ,, ,, in bars .. .. | | £58 | £58 | .. |
| *g* Tin, block .. .. .. .. | per ton | £130 10 to £131 10 | £132 to £133 | £1 10 dec. |
| *g* ,, foil .. .. .. .. | per lb. | 1/6 | 1/6 | .. |
| *n* ,, wire, Nos. 1 to 16 .. .. | per lb. | 1/9 | 1/9 | .. |
| *p* White Anti-friction Metals — "White Ant" brand .. .. | per ton | £35 to £65 | £35 to £65 | .. |
| *j* Yarns, Cotton, Single 10 lb. b'ndl's | per lb. | 8¼d. | 8¼d. | .. |
| *j* ,, Best Flax, 6 lea. .. .. | per lb. | 6d. | 6d. | .. |
| *j* ,, Hemp, 3 ply 10 lbs. .. | per lb. | 4½d. | 4½d. | .. |
| *j* ,, ,, Russian, 10 lbs. .. | per lb. | 5¾d. | 5¾d. | .. |
| *j* ,, Jute, 180 lbs. rove .. | per ton | £14 5 | £14 5 | .. |
| *k* Zinc, Sh's. (Vielle Montagne ord.) | per ton | £22 10 | £22 10 | .. |

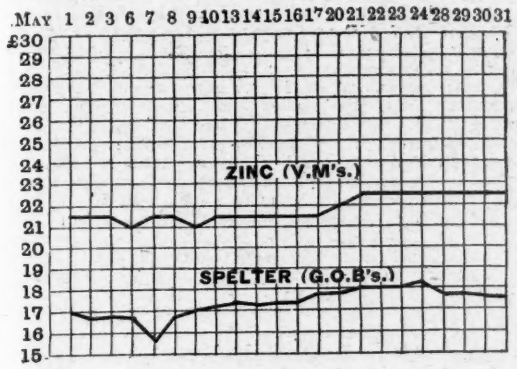
Quotations supplied by { *a* Messrs. G. Boor & Co. *b* The British Aluminium Co., Ltd. *c* Messrs. Thos. Bolton & Sons. *d* Messrs. F. Wiggins & Sons. *e* Messrs. Frederick Smith & Co.

Quotations supplied by { *f* India-Rubber, G.-P. and Teleg. Works *g* Messrs. James & Shakspeare. [Co., Ltd. *h* Messrs. Jackson & Till. *i* Messrs. Bolling & Lowe. *j* Messrs. Henry C. Yeo & Co.

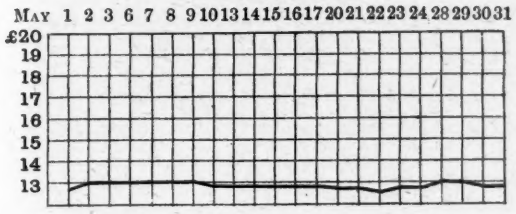
Quotations supplied by { *k* Messrs. Morris Ashby, Limited *m* Messrs. W. T. Glover & Co., Ltd. *n* Messrs. P. Ormiston & Sons. *o* Messrs. Johnson, Matthey & Co., Ltd. *p* The Phosphor Bronze Company, Ltd.

## METAL MARKET.

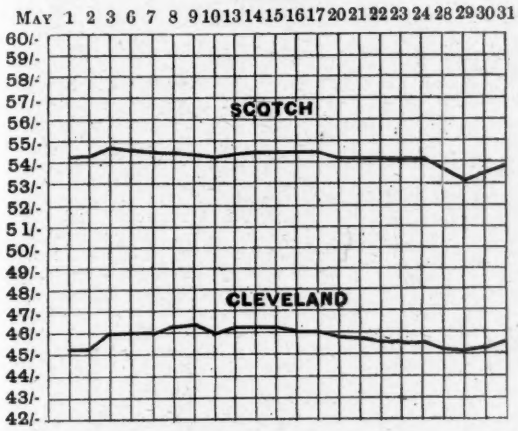
### Fluctuations in May.



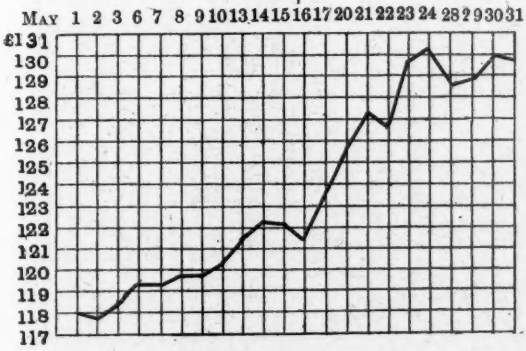

**LEAD (ENGLISH).**



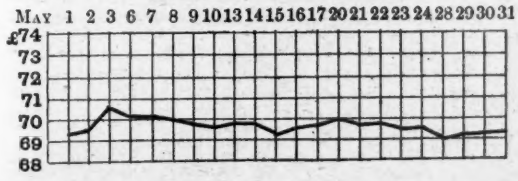

**IRON.**




**TIN.**




**COPPER (G.M.B's.)**




## INSTITUTION OF ELECTRICAL ENGINEERS.

### A WATT-HOUR METER.

By Frank Holden, Member.

(*Paper read May 2nd, 1901.*)

(*Concluded from page 951.*)

The method of calibrating is as follows: After some experience with these meters, one can judge by the rapidity of the return of the deflecting coils, approximately, when the proper tension is on the springs, and these are first adjusted approximately correct.

The meter is then put on the full load, say 500 watts, and the shunt circuit closed long enough to allow the coils to move through the full angle. Then, if the lower part does not make two revolutions in coming to rest, which is the movement in a 500-watt instrument, it follows that the damping effect of the permanent magnet is too great, and it is reduced by an adjustable magnetic shunt across the poles, consisting of an iron screw passing through one of the poles toward the other pole, although, in the meter before you, this shunting is done by laying iron strips across the poles.

When the adjustment for full load is completed, the load may be reduced to one-tenth, and then, if the tension of the springs be correct, with 10 closings of the shunt circuit, the lower part will make two revolutions. If it make more, the tension on the springs is increased by means of the screws, G, and, if less, the tension is decreased, until ten closings produce two revolutions.

If a good guess as to the proper strength of the spring be made in the first place, there will be no need to readjust the magnet for the full-load reading, as it takes a very considerable change in the springs to produce an appreciable effect with full load, as the electrical forces are then relatively very great.

It is easy enough to set up a number of meters of different types, and get very correct readings, but it is a more important and different matter that the properties of the instruments shall be constant.

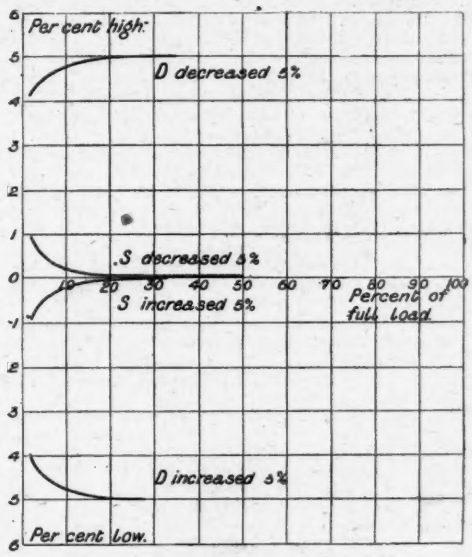

Per cent high:
D decreased 5%
S decreased 5%
S increased 5%
10 20 30 40 50 60 70 80 90 100
Percent of full load
D increased 5%
Per cent low.

Fig. 5.

On looking at the equation of the instrument—

$$\phi = W P \theta \frac{I_r}{I_r + I_c} + \theta \frac{D I_c - S I_r}{D (I_r + I_c)}$$

it will be seen that P, $I_r$, $I_c$, and $\theta$ cannot change except by actual distortion of the parts, for they all depend purely on the dimensions of the construction, and so may be assumed to be constant. This leaves S and D only to be considered.

With S must be included all mechanical friction affecting the motion of the coils. The weight of these coils complete with the shaft is about 25 grams, and it is a matter of experience that the pivot friction, even with a heavier load, will not alter appreciably in a considerable lapse of time. When new it does not seem to be more than 2 per cent. of the couple of the springs; so that if it double it will affect the reading of the instrument even at the lowest loads very slightly, as may be inferred from curve fig. 5. It may be safely accepted that the force of the springs if properly made will be constant.

With D must be included all mechanical friction to which the revolving part is subjected, and this consists of the pivot and dial friction and that of the two pawls. The weight of the revolving part is about 28 grams, and, as in the case of the upper pivot, it does not seem likely that the pivot friction will alter seriously in a considerable time; and the fact that in several instruments the pivot's frictional forces have all been within 50 per cent. of a mean value rather confirms this opinion. As the pivot friction is about

less than 2 per cent. of the total damping force, it evidently may vary considerably in percentage without appreciably affecting the readings of the instrument. As it is not a matter of making the pivot friction small, but of making it constant, it is possible to make the pivots blunter than would be admissible in motor meters or indicating instruments generally, and as a consequence they are much less likely to be damaged in case of shock or vibration than in these instruments.

There has not been a case of a jewel broken or damaged by a pivot in an experience with a dozen of these meters, although some have been subjected to intentionally rough usage.

Driving the dials takes about 3 per cent. of the total damping force, but the fact that all the dials so far tested have taken about the same forces for running makes it seem that they will be constant in their friction, or, should they change, they will have less friction with lapse of time and use, as in the case of those used with the Thomson meter. The uniformity in the force needed to operate the indicating dials taken from many meters was noted by Mr. Evershed in his recent paper.

The damping effect of the two pawls amounts to about 8 per cent. of the total damping force, and seems to be unaffected to any appreciable extent by a considerable change in the surface of the ratchet. Any change here would undoubtedly be in the direction of becoming less as the rubbing surfaces polish; and it cannot become very much less in any event, as a considerable amount of the energy is consumed in raising the pawls over the teeth, and this depends on the mass of the pawls and the depth of the teeth, either of which will alter but little in a very considerable period. So far there has been no sign of alteration in the energy consumption due to the pawls.

The curves given in fig. 5 show the effects of varying the values of S and D 5 per cent., from which it may be seen that a considerable variation of S does not appreciably affect the readings.

The permanence of the hysteresis brake is entirely a matter of experiment. There is no doubt that the tungsten steel magnet, with its poles so thoroughly joined by iron, will be permanent, and the pretty uniform magnetic characteristics of cast-iron, even when taken from widely different sources, would lead one to suspect it to have constant hysteretic properties, and for this reason it has been chosen in place of sheet-iron or steel. There has been no evidence so far that the hysteresis brake is other than constant enough for commercial purposes. The most significant evidence as to the permanence is the result of tests on a meter that had been in existence 12 months, and after that time was 1·0 per cent. too high at full load, and another meter after six months had changed not more than 0·5 per cent., and perhaps less.

The total damping force in the meter here this evening is about 458 dyne centimetres, which seems remarkably small, and is undoubtedly smaller than that employed in any other meter, at least for a maximum force. It is constant regardless of the load, whereas in the Arago disc brakes the moment of the force is proportional to the load, and becomes very small on low loads; consequently, in the latter case, there is needed a much higher maximum moment of the damping force.

The moments of the forces acting on the different parts have been pretty approximately determined. The couple due to the dynamometer at full load is 30,000 dyne centimetres.

The moment of inertia of the deflecting coils is one-third that of the revolving part, and as $\theta = 0{\cdot}40$ nearly, and the angle of revolution $\phi$ of the revolving part is, for full load, $4\pi$, the average couple of the springs and the total damping force may be calculated. This gives

$$S = 316, \text{ and } D = 710.$$

From these values may be calculated the lower limit of reading of the instrument, which is reached when the dynamometer forces are not more than equal to the sum of S and D, the opposing forces; that is, the lower limit is reached when

$$W P = S + D$$

$$W = \frac{S + D}{P} = 31{\cdot}6.$$

This is equivalent to $\frac{\theta}{4\pi}$, which is evidently the lower limit, because of other considerations.

The following results of a test are quite consistent with the above:—

| Watts. | Contacts. | Revolutions. | Revs. per watt per contact. |
|---|---|---|---|
| 25 | 0 | 0 | 0 |
| 30·5 | 17 | 1·02 | ·00198 |
| 50·5 | 20 | 2·015 | ·001975 |
| 100 | 10 | 2·01 | ·00201 |
| 201 | 10 | 4·04 | ·00201 |
| 401 | 10 | 8·15 | ·00203 |
| 600 | 10 | 12·10 | ·002016 |
| 800 | 5 | 8·00 | ·00200 |
| 1,000 | 4 | 7·98 | ·001975 |

The larger sizes may be constructed to start under 2 per cent. of full load, which is sufficiently low for commercial purposes, without reducing the damping force to too small a value.

As stated before, S includes a very small couple due to friction, which is too small to be measured with any definiteness; D includes the force due to the two pawls, equal to 57 dyne centimetres, and the force required to drive the dials is equal to 21 dyne centimetres. From the force exerted by the two coils and their dimensions it is found that the field inside the field coils is at full load closely 95 gausses. From this it is evident that the greatest possible error which may result from the influence of the earth's field is 4 per cent. at $\frac{1}{20}$th full load, which is, commercially, of no account.

The deflecting coils are copper-wound, and have a resistance of about 450 ohms. In series with this is about 550 ohms of German silver in a 100-volt instrument, so that the temperature coefficient of the combination is 0·22 per cent. per degree C. The temperature coefficient for hysteresis being zero or slightly negative at ordinary temperatures, it follows that the temperature coefficient of the instrument will be very closely 0·22 per cent. When constructed for 200 volts the coefficient would be about 0·13 per cent.

The loss in the series coils is, in the small sizes, between 5 and 6 watts at full load.

The shunt circuit is closed for one second once each minute, and consequently the average shunt loss in a 100-volt meter having a shunt resistance of 1,000 ohms is 0·17 watt.

As the shunt current is 0·10 ampere, it would be possible in the case of the use of a large number of meters, that there might be considerable rushes of current because of a large number of shunts closing simultaneously, and if 1,000 meters were on one circuit it would be possible for this intermittent current to be as great as 100 amperes. The probability of the existence of various currents for supplying the shunts loss has been calculated for 1,000 meters, and is shown by the curve fig. 6. From this it is found that on the

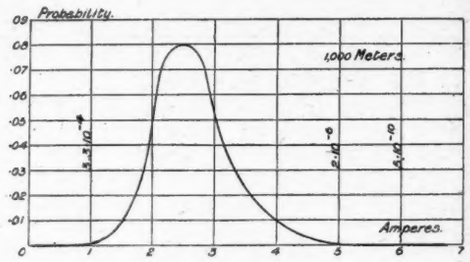



Fig. 6.

average, for 0·75 of the time the total current will be between 2 and 3 amperes, while a current exceeding 10 amperes will not exist for more than $5{\cdot}10^{-10}$ of the time, that is, one hour in 500,000 years.

The theory of the instrument as given heretofore was virtually based on the assumption that there were an infinite number of teeth in the circular rack, so that there was no lost motion. Even at the lowest loads, the greatest possible error from this source for individual readings would not be more than 5 per cent. with the teeth of the rack spaced a millimetre apart. It may be shown that the average error introduced from this cause would be one-half the angle subtended by one tooth of the rack. Even with a dozen readings, the probability of the average error being appreciably different from this is very small. All that is needed, therefore, to eliminate this error is to make the individual movements of the rotating part too great by an angle equal to one-half that subtended by one tooth of the rack. From the general equation of the instrument, it will be seen that this may be done by making S less than would theoretically be required by an amount sufficient to increase the second term of the equation by the desired constant quantity. This is unconsciously done in calibrating.

One characteristic, and perhaps one of the fatal characteristics, of meters of this type, has been the large errors at low loads, and almost always for very similar reasons to those given in the case of the Frager meter; whereas, in the meter which has just been described, it has been found that the accuracy over the whole range of the instrument is good. The reason of this will be seen in comparing two of the most nearly analogous operations in each.

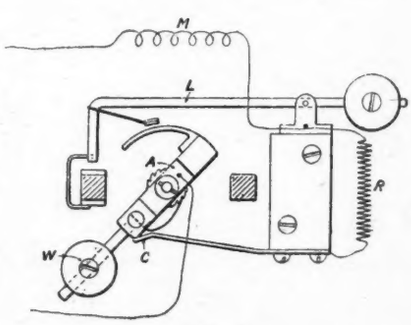



Fig. 7.

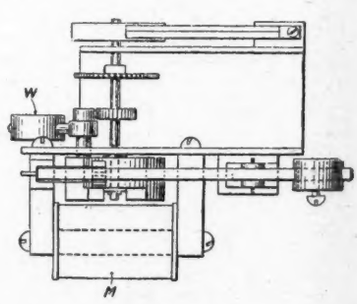



Fig. 8.

In the case of the Frager meter there is the necessity of measuring or indicating a very small angle when the load becomes small, which is very difficult to do correctly. Errors from other sources in this instrument are negligible. The most nearly analogous operation to indicating this angle is, in the new type of meter, the performing of the work $W P \theta$ on the moving parts of the meter.

P and $\theta$, it will be seen, are dependent on the mechanical construction, and $\theta$ being as large as 0·40 radians, and determined by stops, must, therefore, be very definite.

There is never, then, the necessity of measuring or indicating a very small angle, as in previous meters of this class, and that is the one great reason why it has been possible to obtain high accuracy at all loads within the range of the instrument with a comparatively simple construction.

The clock mechanism for operating the short-circuit contact, which must be closed and opened at regular intervals, is shown in figs. 7 and 8. The clockwork is the same as that used in ordinary 2s. or 3s. clocks, only the seconds wheel and escapement parts being used.

The weight, W, carried by the shaft, S, drives the seconds wheel through the pawl, P, which engages with a ratchet wheel on the seconds wheel shaft. The weight falls, and in so doing rotates the armature, A, until one end touches the contact, C. Between C and L there is a resistance, R, and from L there is a connection by way of the coils of the winding magnet, M, to one of the mains. The other of the two mains is connected to the framework of the clock. When A and C touch, a current passes from P through M and R to C, and thence by A through the frame of the clock to N. This current is not sufficient to magnetise the winding magnet so as to rotate the armature A, but is sufficient to attract the iron arm, L, towards the pole of the magnet nearest it. The arm, L, carries at its end a spring contact, S, tipped with silver, which, when the arm L is towards A, makes contact with the cylindrical end of A. The effect of this is to short-circuit the resistance R, and to afford a path more direct, and of lower resistance, from L through A to the frame.

The current through M is now large enough to rotate A, and, in so doing, to raise the weight W. The movement of A is accelerated until its end passes from under the contact S, when the circuit is broken. The kinetic energy of rotation is then expended in the further raising of W.

The current through M being interrupted, the magnet cores are demagnetised, and L falls away to its original position.

The weight W descends in driving the clock, and in time the cycle is repeated with a frequency very closely four per minute.

The power required to operate this arrangement has been measured by passing the current through the armature of a Thomson recording watt-hour meter, while a known constant current was in the field coils. The angular movement of the Thomson armature per cycle of the clock-winding gear would then be a measure of the energy consumed per cycle. In this way it has been found that the average power required on a 100-volt circuit is very closely 0·005 watt.

The same construction is used for either alternating or continuous currents, except for changes in the resistance, R, and the winding, M.

The shafts of the seconds wheel carries a snail-shaped piece of fibre, against the periphery of which press two pieces of light steel watch-spring, forming one terminal of the contact arrangement. The other terminal travels with the fibre snail, and is so placed that the latter, in rotating, gradually raises the springs until they drop on to the revolving contact terminal, off the edge of which they finally drop. The springs move so quickly that the spark at breaking is too small to cause a prohibitive amount of wear.

## THE CONTINENTAL ELECTRICAL ENGINEERING INDUSTRY.

(*Concluded from page* 954.)

*Secondary Batteries.*—The Pollak Accumulator Company (Akkumulatorenwerke System Pollak, Akt. Ges.), of Frankfort-on-Main, has been unable to maintain for 1900 the same rate of dividend as in the three previous years, but the total sum to be distributed is greater, although it is spread over a larger amount of share capital, which now amounts to £100,000 as compared with £50,000 in 1895. A dividend of 6 per cent. was paid in each of the years 1895 and 1896, and 8 per cent. in 1897, 1898 and 1899, whilst the rate for the past year has been reduced to 7 per cent. The net profits for 1900, after meeting expenditure and writing off £6,870 for depreciation, amount to £9,249 as against £8,260 in the previous year. During the second half of the year a diminution in the receipt of new orders took place, especially as considerable reserve was manifested in the establishment in factories and other works of independent installations equipped with secondary batteries. Efforts have been made to meet this deficiency by seeking new spheres of activity, as, for instance, the lighting of trains. The operation of one section of the Frankfort tramways by means of accumulator cars was terminated on the general introduction of the overhead trolley system. The company's report mentions that the turnover of the Vienna branch increased, although no profits were earned. As far as the depreciation is concerned, it appears that 10 per cent. has been written off machinery and 20 per cent. off accessory plant.

The first year's operations of the Upper Spree Accumulator Company (Akkumulatorenwerke Oberspree Akt. Ges.), of Berlin, resulted in a slight surplus of income over expenditure. The surplus for last year amounts to £5,000, which has been written off for depreciation of raw materials. It was stated at the recent general meeting that the course of business does not appear brilliant this year.

*Dynamo Construction.*—The report of the Bergmann Company (Bergmann Elektrizitatswerke Akt. Ges.), of Berlin, for 1900, refers to the decision arrived at last December to acquire the undertaking of the Bergmann Dynamo Company, and states that the amalgamation has already been registered. During the past year the sales of the machine department increased by £75,000, and those of the installation material branch by £38,650. The report issued by the company is only a summary, of which complaint was made at the recent general meeting. The dividend then declared is at the rate of 23 per cent. on a capital of £250,000, as compared with 22 per cent. in 1899. The position of business for the present year is regarded as satisfactory.

### OTHER COUNTRIES.

*Ganz & Co.*—The well-known undertaking of Ganz & Co., of Buda-Pesth, whose name has been associated with the contract for the electrical equipment of the metropolitan railway, has been sensibly affected during the past year by the increasing intensity of competition, although the shareholders have not much ground for complaint in consequence of the reduced dividend, which is still of a satisfactory character. The net profits for 1900 amount to 1,307,490 crowns, as compared with 1,861,170 crowns in the preceding year. This diminished result is all the more regrettable when it is borne in mind that the value of the sales increased by over 8 million crowns, but the severity of competition and the consequential necessity for considerable reductions in prices, combined with an increase in working expenses, are responsible for the less satisfactory trading account. Nevertheless, the profits allow of the payment of a dividend at the rate of 20 per cent. for 1900, as against 25 per cent. in the previous year. Apart from the company's other branches, it may be mentioned that the electrical department has carried out various export orders, and is now largely interested in the electrical equipment of the Italian main line between Lecco, Colico, Sondrio and Chiavenna. The future outlook for the company is not regarded without some apprehensions in view of the necessity for keeping the various works in operation, and unless the commercial situation improves in the near future, a restriction of the output will, in the opinion of the directors, become imperative.

*Swiss Aluminium.*—The operations of the Neuhausen Aluminium Company (Aluminium Industrie Akt. Ges., Neuhausen) are characterised by the directors as having corresponded to the anticipations entertained in regard to the year 1900, notwithstanding the slight decline in the dividend. Apart from the mortgage bonds, amounting to £240,000, the nominal capital is now £640,000, of which one-half is fully paid up and entitled to participate in the profits. The company has three works: the first at Neuhausen, the second at Rheinfelden, and the third at Lend, and all three have been fully employed during the year. The gross profits realised £84,360, being £6,680 in excess of those obtained in the previous year. Of the former the sum of £30,000 has been written off for depreciation, the dividend absorbs £40,000, and the balance has been disposed of by allocations to reserve and other purposes. It is proposed to pay a dividend at the rate of 12½ per cent., as compared with 13 per cent. in 1899, 12 per cent. in 1898 and 1897, and 10 per cent. in 1896 and 1895. It is noteworthy that the company's patent account has been entirely wiped out, large sums having been written off in earlier years for this purpose.

*French Thomson-Houston.*—This company, which is largely interested in the promotion of electric tramway enterprises, found it necessary to hold the annual meeting earlier this year, in order to inform the shareholders of the general position of affairs due to the crisis which arose in connection with tramway and traction securities. The net profits for 1900 amount to £209,900, as compared with £205,250 in the previous year, and the dividend of 55 francs per share is equal to that paid for 1899. Apart from the construction of various tramways, the company has executed an order for the Paris Metropolitan Railway, and hopes are entertained that the latter will entrust it with the equipment of the extensions of that railway. The conversion of other railways, and especially those on the borders of the Mediterranean and in the neighbourhood of Paris, is regarded as being in prospect. The company is largely interested in the Etablissements Postel-Vinay, which mainly works for the former and has carried out important telephone and telegraph contracts.

*Milan Edison.*—There is no diminution in the prosperity of the Milan Edison Company which increased its turnover from £252,000 in 1899 to £312,000 last year, whilst the expenditure only advanced by £20,000. A large portion of the additional revenue has been devoted to the purpose of writing down the assets, although the dividend has been raised from 10⅜ per cent. to 12½ per cent. It is believed that the current year will be equally as satisfactory as the past 12 months.

## ELECTRICAL PROGRESS IN AUSTRALASIA.

MR. LAWRENCE BIRKS writes in the current issue of the *American Electrician* on this interesting matter. He, of course, looks at it through American spectacles, but it is none the less interesting to Englishmen on that account. He says:—

"The progress of electrical work in the new commonwealth is steady if not rapid, the tendency being to remodel existing plants on up-to-date lines. In Melbourne, Richmond, Bendigo, and other large cities, the old two-wire 110-volt plants are being scrapped in favour of large three-wire 440-volt systems. For this class of town lighting plant direct-coupled vertical enclosed high speed engines are in favour, usually of the manufacture of Willans, Bellis, or or other well-known British builders. Great developments in

water-power schemes are promising in New Zealand and should be carefully watched by firms who are interested in selling the requisite apparatus. The city councils of Auckland, Dunedin, Gisbourne and Wellington have all obtained expert reports and are seeking Parliamentary powers to proceed with works costing from $250,000 to $750,000 each. In electric traction rapid progress is being made. Here, of course, American apparatus holds its own. In Sydney, N.S.W., the present Government traction station, equipped with four Allis-General Electric 850-KW. sets, is taxed to its utmost, and three more 1,500-KW. three-phase 6,600-volt units by the same makers are on order, together with equipment for five 1,000-KW. sub-stations. A large number of smaller towns have tramway systems in hand, Messrs. Noyes Bros., representing the Westinghouse Company, being particularly active. In power distribution there are three high tension polyphase stations in operation in Victoria for supplying gold dredging barges with power for pumping, the plant in two of them being American, in the third local. The Kalgoorlie (W.A.) Electric Power Company, which is slowly maturing its plans, promises to supply the mines of that district with an up-to-date system, but there is still a large and almost untouched field in Australian mining for electrical development. With the introduction of electric power to the larger cities the possibilities of electric elevators are beginning to be recognised, and some three or four have been installed from the Sprague and Otis factories. But there is a big prejudice among the architects to be overcome. Good illustrated catalogues will go a long way in removing this prejudice. Australian engineering firms have their possibilities fully taxed to supply the demands of the mining and hydraulic industries which are more or less peculiar to the districts. In electrical equipment standard imported lines will prove far more satisfactory than anything which can be manufactured here at present. The long time of mailing and delivery remains a great difficulty. This should be partially overcome as the demand becomes more steady, and importing firms can carry larger stocks. For the present it can only be minimised by careful catalogluing."

## NIAGARA POWER DEVELOPMENTS.

By ORRIN E. DUNLAP.

ONE of the most important announcements ever made in connection with the development of Niagara power comes just now, the Niagara Falls Power Company officially stating that it will at once begin the development of the power of the Horseshoe Fall, on the Canadian side at Niagara, under the rights of the charter held by the Canadian Niagara Power Company, which is controlled by the Niagara Falls Power Company.

The method of development will be by means of an inlet canal, a wheel pit and a tunnel tail race, the portal of which will be at the foot of the Horseshoe Fall.

The plans for the first development call for 35,000 H.P., but the wheel pit and tunnel will have a capacity of 100,000 H.P., an additional development to be made as necessity requires. The power that is to be developed can only be used outside of the limits of Victoria Park, the beautiful plot skirting the falls on the Canadian side, and it is expected that an industrial centre similar to that established on the New York side will develop there with considerable rapidity after the developed force is available. It is further expected that 10,000 H.P. will be transmitted to Toronto, while a similar amount will be held in reserve for the Niagara Falls Power Company and its uses on the Canadian side.

Work will begin with the construction of the inlet canal, and this will lead from the head of Cedar Island to the site of the power house. This power house will be located at the foot of the high bank west of the head of Cedar Island. The construction will give a head similar to that in use in the power house on the American side, the details of which construction as well as of the machinery, both dynamos and turbines, will be followed in the Canadian installation.

The contract for the work has been awarded to A. C. Douglass, who built the shaft and extension of the tunnel in connection with the new wheel pit on the New York side. The development will be made by the Niagara Falls Power Company, which will finance and manage the undertaking in harmony with its American plant. The power house on the Canadian side and the two power houses on the New York side, will have cable connections for an exchange of service should necessity require.

The original agreement between the Commissioners of Queen Victoria Niagara Falls Free Park and the Canadian Niagara Power Company was signed on April 7th, 1892, and it remained in force until July 15th, 1899, when a new agreement was made. Under the provisions of the first agreement, the Canadian Niagara Power Company held the exclusive right to the development of power in the Victoria Park. With the advent of the Ontario Power Company, or just previous thereto, the Canadian Niagara Power Company showed a willingness to give up the exclusive right, and a new agreement was made. Under this later agreement the Canadian Niagara Power Company is given until July 1st, 1903, to have 10,000 developed horse-power ready for use, supply, and transmission, and also to have water connection made for 25,000 H.P. The company has until July 1st, 1904, to clean up and ornament the surfaces which may be disturbed by its work. The excavated material is to be disposed of either by way of extension of the foreshore of the Niagara River in an easterly direction from the edge of the Horseshoe Fall southward along the river bank, or in filling up the natural stream of the Niagara River between Cedar Island and the mainland, or in raising the level of the west bank or shore of Cedar Island, and all surfaces to be left in good condition for sowing grass seed or planting. It is further provided that steam power shall not be employed on the work in the surface of the park, but below the cliff only, but steam power may be used to furnish compressed air. If the cleaning up and grading is not completed at the time specified, then the company is to pay $10,000 ascertained and liquidated damages and $500 per week during the period it remains incomplete.

The rental for the first ten years under the original agreement was to have been $25,000 per annum, and during the second ten years it was to increase $1,000 annually until it reached $35,000, at which sum it was to continue if the company desired a renewal of the permit. Under the new agreement the terms of rental were so amended by providing that from and after May 1st, 1899, the rent payable up to May 1st, 1949, shall be $15,000 per annum, and in addition thereto payment at the rate of $1 per annum for each electrical horse-power generated and used and sold or disposed of over 10,000 E.H.P. up to 20,000 E.H.P., and the further sum of 75 cents per horse-power over 20,000 H.P. up to 30,000 H.P., and the further payment of 50 cents for each electrical horse-power over 30,000 H.P., which is to say, by way of example, that on generation and use and sale, or disposal of 30,000 E.H.P., the gross rental shall be $32,500 per annum, payable half-yearly. These rates are to apply for power used or supplied in the United States or Canada. Within 10 days of the first day of May and November the company is to furnish the Commissioners a verified statement of the power generated and sold.

After May 1st, 1949, the same rentals are to continue unless the Lieutenant-Governor-in-Council shall desire a re-adjustment, in which case a re-adjustment shall take place for a further period of 20 years, and if the parties cannot agree the matter shall be arbitrated. The Commissioners on their part agree not to compete in the development of power, but should they grant privileges to other parties who shall fail to keep their agreement and the Commissioners be forced to take over the plant, then the agreement in question will not prevent them from operating such works. The Commissioners agree not to allow any other company cheaper rental for similar privileges. The Canadian Niagara Power Company agrees not to amalgamate with any other company heretofore or hereafter incorporated under the laws of the Dominion without the consent of the Lieutenant-Governor in Council.

The fact that the Canadian Niagara Power Company will at once break ground will enable it to complete its work in two years.

## OUR LEGAL QUERY COLUMN.

[*Questions addressed to the Editors for insertion in this column should be as brief and concise as possible. Free use of fictitious names, &c., may be made. Answers are furnished by a duly qualified lawyer, but the Editors cannot undertake to be responsible for the accuracy of the views which he may express.*]

"TOWN CLERK" writes:—"I should be very glad to have the benefit of your opinion upon the following points:—The Corporation of the town which I have the honour to represent have obtained the necessary powers for laying down an electric tramway system in their own district. Prior to making application for such powers, the idea of supplying electricity for lighting purposes had not been mooted, but the committee have now determined to undertake the lighting of the town. The question is, can they do so under the provisional order which they have already obtained? It is obvious that much expense could be saved by using the same conduits for mains, while the posts supporting the trolley wires will serve for arc lamp stands. If you think that it will not be possible for the corporation to take this opportunity, please be so kind as to give them the benefit of your experience as to the course which should be pursued."

*** The questions raised in the above query are of considerable importance, as the harmonious working of electric lighting and electric tramway systems, especially when both undertakings are in the hands of a corporation, often leads to economy for the benefit of the ratepayers. So far as we have been able to examine them, the legal text-books are silent upon the point whether an electric tramway company may undertake the supply of electricity for lighting and power purposes without special powers in that behalf. It would be necessary, therefore, to examine the Electric Lighting Acts somewhat closely in order to ascertain the state of the law upon the subject. But it seems to us that the corporation for whom our correspondent is acting, are in the same position as private persons with regard to the supply of electricity. The question upon which they must be satisfied is, What will be the consequences of our furnishing a supply of electricity?

There is certainly nothing in the Electric Lighting Acts which makes it compulsory for all persons to obtain Parliamentary powers, and subject to compliance with the laws relating to nuisance, negligence, and other matters, in respect of which the proprietors of an electric lighting adventure might come into conflict with owners of private property, there does not seem to be anything to prevent a full exercise of all the necessary powers.

The laying of pipes and wires in streets could be effected by arrangement with the highway authority; and in the present case the corporation are probably themselves the highway authority, while the execution of similar works on private property could be made the subject of agreement with the owners. No authority upon this point in connection with the supply of electricity can be found in the law reports; but there is one case in which the right of a gas company to supply gas without the sanction of a provisional order was tacitly admitted [See Att. Gen. *v.* Cambridge Consumers' Gas Company, L.R. 4 Ch. 71; 38 L.J. Ch. 94; 17 W.R. 145]. The point under discussion in that case was whether the company could be restrained by injunction from up-rooting the streets on the ground of nuisance to persons lawfully using the highway. It was decided that in the absence of evidence of permanent obstruction the Court should not grant an injunction. Nor does it seem that a company which proposes to supply electricity need obtain the leave of the Board of Trade. Upon this point, however, we have always recommended those who have consulted us to communicate with the Board of Trade before they allow any lines to cross the highway which might prove a source of danger to the travelling public.

---

"PERPLEXED" writes:—"My firm undertake to supply and erect private electric lighting installations. We manufacture dynamos and the strictly electric parts of the plant ourselves, but steam engines, gas engines, shafting and the smaller essential parts of a fully equipped installation are supplied to us by independent firms. By a contract which was entered into in December, 1900, we undertook to erect an installation on the premises of a customer on or before June 15th, 1901, and to surrender the same to him in full working order on or before that date. Owing to the failure of the contractor whom we have employed to supply the engine (which was of peculiar construction and cannot possibly be replaced), it seems likely that we shall not be able to fulfil our contract for some considerable time. We might add that he is not under penalty to supply at any particular time, though his contract provided for delivery of the engine on or before May 1st. As we are bound to pay liquidated damages to the extent of £5 5s. a day for every day after June 15th until the plant is in working order, we stand to lose a considerable sum. Will you be so good as to advise us in the matter, giving us the benefit of your opinion as to whether—

"(*a*) The failure of our contractor to supply us affords an answer to a claim by our customer for penalties.

"(*b*) In an action brought by the customer against us do we stand to lose £5 5s. a day, or will the Court interpret the covenant as a covenant to pay penalties and so grant relief to the extent of reducing the claim to the actual damage sustained by the customer.

"(*c*) Should we be compelled to pay damages to our customer? Can we recover the same or any and what part thereof from the engineers whose failure to deliver the engine in good time will have been the cause of our trouble?"

*** With regard to question (*a*) which "Perplexed" has addressed to us, it is a little difficult to give a satisfactory answer without having access to the exact terms of the penalty clause by which his firm are bound. Apart from the "strike clause," which excuses the contractor from the consequences of delay caused by labour troubles, it may be taken as a general rule that the contractor will not be relieved from penalties, except in the following cases:—

(1) The total destruction of the work in hand, *e.g.*, by fire. This releases both parties;

(2) Interference by the employer which causes delay;

(3) Additional works or alterations need not be executed within the time limited by the penalty clause, unless there is an express agreement to that effect.

Seeing that our correspondent's customer is probably oblivious of the methods adopted by the firm with a view to completing their contract, it would clearly be inequitable that delay on the part of a sub-contractor should prejudice the customer. Our answer to question (*a*) must therefore be that no such plea will avail our correspondent's firm.

With regard to (*b*) it is always difficult to decide whether the Court is likely to award the full sum mentioned in the penalty clause. The purposes for which the customer required the plant will have an important bearing upon the determination of this question. Where the parties anticipating the likelihood of a breach of contract have fixed the sum which is to become payable on such breach, if the damages are such as to be incapable of easy estimation, the law will regard the amount as "liquidated damages," and will order payment accordingly. The true principle was thus expressed by Lord Coleridge:—"Where the damage is entirely uncertain, and the parties agree upon a definite and not unreasonable sum by way of liquidated damages, then that sum will be regarded, and will be recoverable." In these circumstances we can only advise that if our correspondent's firm can show that less damage than to the extent of £5 5s. a day has been occasioned he may have the amount reduced by a substantial sum.

With regard to (*c*) we think it is clear that unless when the order was given to the engineers, special attention was drawn to the perilous consequences of delay, it will be difficult for the plaintiffs to recover all the damages in which they will be mulcted to their costumers. Of course, it is possible that the Court will consider that such damages were the necessary consequences of the engineer's breach of contract, and that he must be taken to have been aware of such consequences. Nevertheless, the Court usually requires something akin to notice in writing to fix a man with such heavy liability.

## NOTES ON THE THEORY OF SYNCHRONOUS MOTORS AND OF ALTERNATORS IN PARALLEL.

BY ALEXANDER RUSSELL, M.A.

(*Continued from page* 921.)

*The Fundamental Equation of a Synchronous Motor.*

If C be the current in the circuit, then

$$C^2 I^2 = E_1^2 + E_2^2 + 2 E_1 E_2 \cos\theta.$$

Combining this equation with (3) we get the following equation for steady running,

$$C^2 I^2 = E_1^2 - 2 W_2 I \cos\gamma - E_2^2 \cos 2\gamma - 2 \sin\gamma \sqrt{E_1^2 E_2^2 - (W_2 I + E_2^2 \cos\gamma)^2}. \quad (5)$$

If we regard $E_1$ as the variable, or, in other words, if we vary the excitation of the generator, then the minimum value of C is $\frac{W_2}{E_2}$, but if we vary $E_2$ then the minimum value of C is $\frac{W_1}{E_1}$. These results can be proved analytically from (4), but it is more instructive to prove them graphically from first principles.

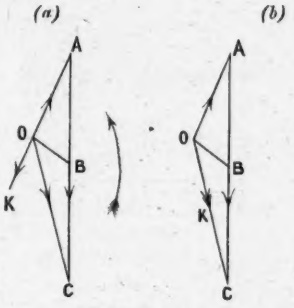



FIG. 3.

(*a*) In fig. 3 gives the diagram for the minimum value of C when $E_1$ is the variable and (*b*) gives the diagram for the minimum value of C when $E_2$ is variable. If we vary $E_1$ then since $-C E_2 \cos A O K$ equals $W_2$, it follows that C will be a minimum when $-\cos A O K$ is a maximum, *i.e.*, when O K and O A are in the same straight line. In this case O K (C) lags behind B C, the P D at the terminals of the generator. Hence the current is lagging and the power factor of the circuit is the cosine of the angle O A C. We can see that as we increase the excitation of the alternator the power factor is a maximum before the current in the circuit is a minimum.

If we vary $E_2$, then (*b*) is the diagram when the current is a minimum. In this case C and $E_1$ are in the same phase, and the current is in advance of the P.D. (B C) between the terminals. The cosine of the angle O C B is the power factor, and it has its maximum value before $E_2$ attains the value that makes the current a minimum. In practice it is often found advisable to work with an excitation greater than that required to give the minimum current, as although we are working at a less efficiency, the power factor being smaller, yet the regulation is better, as the angle between $E_1$ and $E_2$ will be greater.

We can show from (3) that for a given load, $W_2$, the only possible values of $E_2$ lie between

$$\frac{E_1}{2\cos\gamma} + \sqrt{\frac{E_1^2}{4\cos^2\gamma} - \frac{I W_2}{\cos\gamma}} \quad \text{and} \quad \frac{E_1}{2\cos\gamma} - \sqrt{\frac{E_1^2}{4\cos^2\gamma} - \frac{I W_2}{\cos\gamma}} \quad (6)$$

The above results point out the following method of procedure when we desire to increase the efficiency by raising the voltage. First adjust the excitation of the motor until the current is a minimum. Then increase the excitation of the generator until the current is again a minimum. Then go back to the motor, and increase its excitation until we

reduce the current again to its smallest value, and so on, backwards and forwards between the two machines until we attain the desired efficiency and stability. In practice a limit to the possible excitation is soon reached, but it is useful to know the above rule as it may help electricians to avoid blowing fuses or allowing the motor to drop out of synchronism by varying the excitation of one machine only, without also varying the excitation of the other.

As the equation (4) is complicated we have illustrated it graphically by drawing curves for various particular cases. It is to be remembered that we have made the assumption that the current vector and the E.M.F. vectors are in one plane, and we now make the further assumptions that the impedance (I) and the angle of lag ($\gamma$) remain constant as the excitations vary. The curves arrived at are very similar to those obtained by actual experiments, and show that the main phenomena of the working of synchronous motors could have been predicted from the properties of triangles.

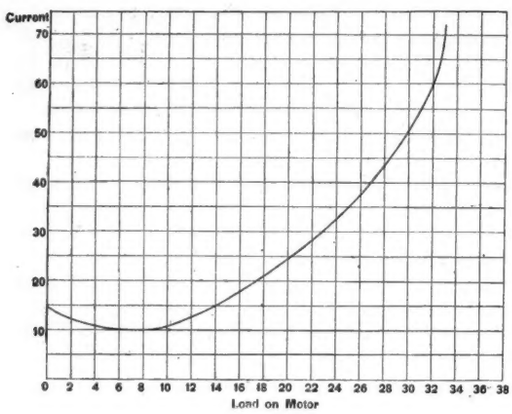



FIG. 4.

The anomalous results sometimes obtained in practice show, however, that in some cases our assumptions are not approximately true.

In fig. 4 a curve is shown illustrating how the current varies with the load on the motor when $\gamma$ is 45°.

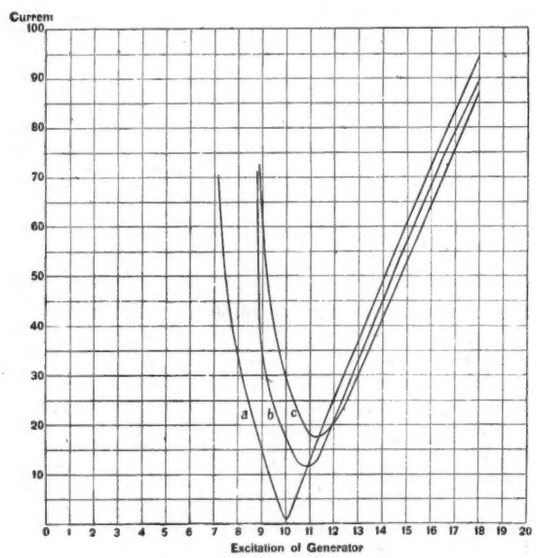



FIG. 5.

It will be noticed that when $w_2$ is zero there is quite a large current. The current attains a minimum value for a particular load and it varies very little for an increase or diminution of that load. On the other hand, when the load is heavy a slight increase of it will cause a large increase of the current.

Fig. 5 shows how the current varies with the excitation of the generator for three different loads which are to one another in the ratios 1 : 16 : 25 ($\gamma = 45°$). When running at a high voltage increasing the load diminishes the current, but at a low voltage increasing the load increases the current.

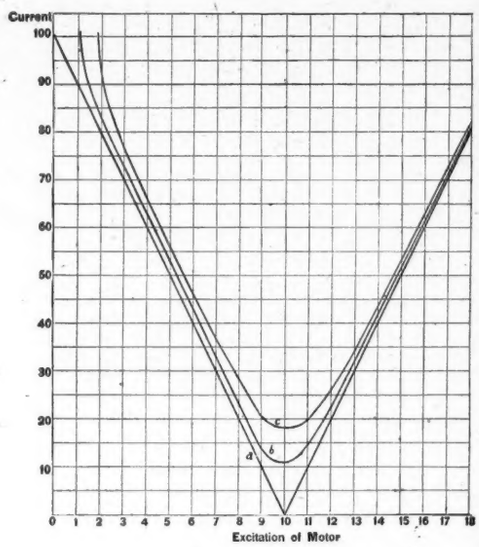



FIG. 6.

The curves in fig. 6 show how the current varies with the excitation of the motor when $\gamma$ is 90°, "$a$" shows the machine running on a very light load. If the load were absolutely zero, the curve would become two lines meeting one another at the point 10 on the axis of $x$. There is no superior limit to the excitation. "$b$" shows the machine running moderately loaded, and "$c$" running on a heavy load. The curves do not intersect one another. This is only true, however, in the unpractical case when $\gamma$ is 90°. In order to obtain this, the resistance of the circuit would have to be zero. The efficiency would thus be 100 per cent. at all loads and excitations.

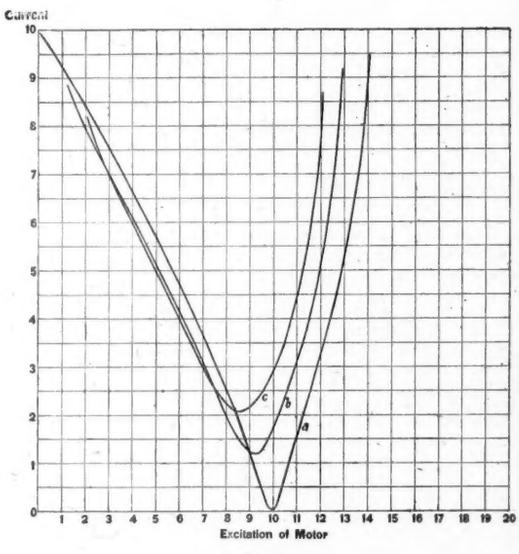



FIG. 7.

In fig. 7 we have taken $\gamma$ equal to 45°, all the other data remaining the same as in the preceding illustration. This is a practical case, and the curves cross one another in the same way as the experimental curves do. It is worth noting that we need to diminish the excitation as we increase the load.

*(To be continued.)*

## CURRENT SPECIFICATIONS.

### LXIV.—WARRINGTON EXTENSIONS.

SUMMARY.

*Extent of Contract.*—Supply and erection upon prepared foundations of one steam dynamo.
*Type of Engine.*—To be of the compound three-crank enclosed type, made by Messrs. Willans & Robinson.
*Steam Pressure Available.*—150 lbs. per square inch.
*Normal Output.*—500 KW.
*Type of Dynamo.*—Multipolar, the armature spider being extended and flanged so as to form a coupling for bolting to engine fly-wheel.
*Permissible Temperature Rise of Dynamo Windings.*—After six hours' full load run not to exceed 60° F. for armature, or 70° F. for field magnet coils.
*Guaranteed Steam Consumption.*—To be stated in tender.
*Combined Efficiency.*—To be similarly stated in tender.
*Type of Shunt Resistance.*—To be of Ferranti type, with cast-iron pillar and switch hand-wheel, and to be capable of regulating dynamo voltage between 500 and 460 volts at constant speed.
*Guaranteed Date of Delivery.*—To be stated in tenders.
*Penalty for Late Completion.*—*One per cent.* of contract price per week.
*Specified Terms of Payment.*—Monthly certificates to be given up to 40 per cent. of value of goods delivered or work done; a further 40 per cent. to be paid when plant is put into use; 10 per cent. on engineer's certificate that the whole of the works have been completed, and 10 per cent. six months later.
*Specified Period of Maintenance.*—Six months from date of completion.
*Stipulations as to Removal of Foreman.*—Satisfactory.
*Stipulation as to Wages Paid to Workmen.*—Satisfactory.
*Arbitration Proposals.*—Acceptable.
*Date for Receipt of Tenders.*—June 13th, 1901.

The specification before us has been prepared by Mr. A. H. Preece, A.M.I.C.E., of the firm of Messrs. Preece and Cardew, who was responsible for the design of the original station.

It will be noted that no option is given as to the make and type of engine, Messrs. Willans' compound being distinctly specified. It is open to tenderers to include any make of dynamo in their offer, almost the only special feature insisted upon being that the spider of the armature shall be extended to permit of securing it to the engine fly-wheel.

The date of delivery which the tenderer is prepared to guarantee under a penalty of *1 per cent.* of contract price per week must be given in the tender, and in like manner the steam consumption per KW. hour, and the combined efficiency is to be stated on a form bound in with the specification.

The terms of payment are satisfactory. It is stipulated that standard rates of wages shall be paid, this clause not to be binding as to the supply of materials or patented articles, and there is little to object to as regards the powers of the engineer to interfere with the workmen engaged on the contract. The arbitration clause is of a limited character, all questions as to the real meaning of the specification or of the drawings being referred to the engineer for final decision, all other matters being submitted in case of dispute to the arbitration of the President of the Institution of Civil Engineers or his nominee. We have repeatedly stated that these limited clauses are unsatisfactory, but this is a case in which it must be decided by each individual tenderer, whether or not he is prepared to view the risk involved in the reservation.

### LXV.—PETERBOROUGH EXTENSIONS.

SUMMARY.

*Extent of Contract.*—Supply and erection of one 120-KW. steam dynamo, also of one Lancashire boiler.
*Size of Boiler.*—To be 30 ft. long by 8 ft. diameter, capable of evaporating 7,500 lbs. of water per hour and of working at 160 lbs. per square inch pressure.
*Extent of Boiler Fixing to be done.*—All necessary brickwork, boiler setting, and flues to be done by contractor under this contract.
*Type of Steam Engine.*—To be Willans three-crank single-acting type, to run at a speed not exceeding 400 revolutions per minute.
*Available Working Pressure.*—Presumably 160 lbs. per square inch.
*Type of Dynamo.*—To be of two-pole direct current type.
*Output of Dynamo.*—To have, at normal speed, an output of 300 amperes at 400 volts, and to be capable of a 10 *per cent.* overload on this load for four hours without injurious heating. Also to be capable of working up to 440 volts, presumably with reduced current.
*Permissible Temperature Rise.*—Not to exceed 60° F. after a six-hour full-load run.
*Specified Steam Consumption.*—Not to exceed 25 lbs. per I.H.P.-hour, when working non-condensing, presumably with 160 lbs. pressure. Best figure obtainable working with 27-inch vacuum to be stated.
*Specified Combined Efficiency.*—Not to fall below 85 per cent. at full load and 75 per cent. at half-load.
*Specified Date of Completion.*—October 1st, 1901, for both sections.
*Penalty for Late Completion.*—Amount not stated, but penalty to be inflicted if plant is *more than a month late.*
*Specified Terms of Payment.*—75 per cent. within one month of delivery at Peterborough, 15 per cent. on completion of erection, and 10 per cent. at end of six months' period of maintenance.
*Arbitration Proposals.*—Satisfactory.
*Date for Receipt of Tenders.*—June 14th, 1901.

Mr. J. C. Gill, A.M.I.C.E., the city engineer, has prepared this specification. Like the one just noticed, there is the same partiality for one particular type of engine, which is specified by name. We think that in following this course an engineer departs from the best course of procedure. His duty is to specify ends to be obtained, not to detail the means by which the contractor shall attain those results. By specifying a particular type of plant he removes the responsibility of the satisfactory attainment of specified ends from the contractor to himself, and places himself in a false position in respect to his employer.

There is little to add to the technical portion of the specification in Section 1. All boiler setting, brickwork and flue building is to be included in the contract, and should have full allowance made for it in the tender.

The arbitration proposal follows the wording of the standard clause, the terms of payment are satisfactory, and as to other proposals they will be embodied in a contract which will be prepared and submitted to the successful tenderer after his offer has been accepted.

The date of completion is very close, but a month's grace will be allowed before the mutually agreed upon penalty clause becomes operative.

## DESIRABILITY OF TRAMWAY SECURITIES AS INVESTMENTS.

UNDER the above heading Mr. J. G. White contributes an article to the Special Railway Number of the *Engineering Times*, which, so far as investors are concerned, may be summarised as a recommendation not to put their money into such securities without first consulting "an intelligent engineer to advise as to the adequacy of the charges" upon which "*the relation of capitalisation to net earnings*" is based.

The writer remarks that "the books of tramway companies are seldom falsified," a somewhat disquieting suggestion for shareholders, who must feel like people in a public assembly who are warned to take care of their pockets, as there are thieves among them.

Mr. White says that "inadequate charges to maintenance are frequent, even under the most conscientious management," and he also points out the danger "in not realising what is necessary to adequately provide for depreciation."

These errors in accountancy are not limited to tramway undertakings, as we have frequently pointed out in connection with electricity supply accounts, but it is not the less useful to direct attention to the matter again and again.

Investors in tramway companies cannot be strictly limited to two classes only, viz., the permanent and the speculative shareholder, unless those who take an interest in undertakings of the kind for indirect objects are included among the speculators.

Mr. White advises both classes of investors to study the factors determining the values of the respective properties, and the mere catalogue which follows of only the "chief" factors determining the value of a tramway, offers such a study to intending investors, that between the issue of the prospectus and the date for closing the subscription no amount of cramming from the most efficient coach or pro-

fessor could fit the intended purchaser for paying his deposit with a clear conscience.

Mr. White points out the theoretical conditions under which tramway and light railway schemes should be considered—they are, indeed, the A B C of the promoter—but the provision of ways and means does not depend upon such precise methods, and to depend upon interesting the permanent investor by proving that all such conditions of success exist is practically impossible.

The investor herds often in flocks—thus we have the mining community, the railway shareholder, those who prefer the great drinking business or various industrial enterprises, and the great establishments where the issue of prospectuses is carried on, have their well-selected directories of shareholders classified under their respective investments, to whom the issues are made of new schemes.

The cautious investor limits himself to the dividend-paying undertaking, paying a higher price for a proved success than the more speculative man who goes in on "bed-rock" with a view of securing some of the profits of the pioneer who claims special terms for incurring the initial risks.

Tramways are among the most promising investments, and the number of those who look upon them as such rapidly increases, as the value of the shares in well established undertakings proves.

The investor studies the share list with more interest than the "factors determining the values of the respective properties." Shares of £10 nominal, quoted at 23¼ to 23¾, with rising dividends of 6½, 7½ and 8 per cent., have more fascination than Mr. White's theories; but on the other hand, the investing public put their faith in the great organisations for promoting the tramway and light railway interests of the country, knowing that all the knowledge and practical skill centres there, for creating the improved means of transit for which there is so great a necessity.

The great problem is in strong hands—and it only requires less obstruction on the part of local authorities and more facilities from our legislators to bring this country at least up to the level of the Americans and Continental nations.

## THE CASTNER-KELLNER CASE.

LET all who cherish a belief that scientific assessors should be employed by the Court during the trial of patent actions, make a study of the judgment delivered by Mr. Justice Buckley in the case of Atkins and Applegarth *v.* The Castner-Kellner Alkali Company, the greater part of which was published in the ELECTRICAL REVIEW for May 24th, 1901, at p. 874. Even if we were inclined to disagree with the conclusions at which the learned judge has arrived, it would be impossible to restrain a few words of admiration at the extraordinary grasp which his Lordship displayed of the subject with which he had to deal. His reputation at the Bar was that of a great authority on the law relating to limited liability companies; but he now talks of "cathodes" and "anodes," of "electrolysis" and "electromotive force" with the same ability which he used to display in dealing with preference shares and debentures. No doubt his judgment was aided materially by the counsel who argued, and by the scientific witnesses who gave evidence before him. Howsoever that be, after a trial extending over a period of nine days, the learned judge pronounced against the plaintiffs' patent in a manner which showed that he had completely mastered those nicer points of scientific evidence which so often conceal the true issue in a patent case from the eye of the Court.

So exhaustive is the judgment that its careful perusal will reveal even to the comparatively unscientific mind all the important questions in the law of patents to which a lengthy inquiry of this kind must necessarily give rise.

The subject matter of the patent, which the plaintiffs sought to uphold, was "Improved means and apparatus for separating alkaline and earthy metals and other products from the salts of such metals, or from other substances containing them." The process was one in which a solution of sodium chloride in water is subjected to an electric current while in contact with mercury, with the result that nascent sodium as and when set free is precipitated into and forms an amalgam with the mercury. At the date of the plaintiffs' patent it was well known that when such a solution was subjected to electrolysis it was split up, chlorine being liberated at the anode and sodium at the cathode pole; and that if the cathode pole was formed of mercury, that metal would absorb and amalgamate with the nascent sodium. It was also known that by heating sodium amalgam in water, or by subjecting it to the action of electricity when in water, caustic soda in solution would be formed. The plaintiffs in their specification stated the knowledge which they admitted to have existed at the time, and went on to say that heretofore it had not been found possible, *i.e.*, industrially or commercially possible, to apply the electrolytic process to the purpose of separating metals from their salts, because, as they said, counter-electromotive force had been set up at the cathode by the metal and hydrogen to such an extent that the electromotive force required to effect the decomposition and deposit the metal in opposition to the back-electromotive force had been out of proportion to the industrial result obtained. Substantially, therefore, the plaintiffs claimed an invention which had for its object the production of caustic soda by electrolysis with a saving of power. Mr. Justice Buckley found that they had failed to attain this object. The efficiency of their apparatus was about 50 per cent., and the caustic produced was so mixed with brine as to be commercially of little or no value. "In my judgment," said his Lordship, "the plaintiffs' process is not useful as indicating anything by which caustic could be obtained with greater efficiency than by previous methods." On the question of infringement, after describing the apparatus used by the defendants, his Lordship said, "Assuming in the plaintiffs' favour that a patent for a continuous flow of mercury over a metal base is valid, the defendants did not adopt a continuous flow in one direction, nor did they adopt a compound cathode of which some part was a metal base, but theirs was an apparatus of which it was the essence that the cathode should be mercury only, and that the base should be of non-conducting material." Thus judgment was entered for the defendants upon a very narrow point.

It will be seen that like many other important patents, and in particular like many important electrical patents, the process for which the plaintiffs in the foregoing case were striving to protect their monopoly involved neither more nor less than the application of a well-known scientific principle to the manufacture of a useful commodity upon a large scale. It might be said that 90 per cent. of the patented articles which are to be found in practical operation at a generating station involve the application of principles discovered years ago by the scientific investigator in his electrical laboratory, which have now been called into the service of man. The virtue of these so-called inventions lies in the conversion of the laboratory experiment into a thriving industry. That a method of effecting such conversion deserves recognition at the hands of the Patent Office goes without saying. It is said that the chemist has already produced cane sugar in his test tube; upon him who produces it for 1½d. a lb. in the factory vat there should fall a great reward.

A short discussion of the question whether the discovery of a cheaper process is good subject matter for a patent may be of interest.

It is beyond all doubt that it is no objection to a patent for a process to show that a prior patent has been granted for another process which arrived at the same result, provided the second process be new in itself, and distinct from the first. Lord Westbury illustrated this principle in the case of Curtis *v.* Platt in the following words:—"If the idea started by one man be nothing in the world more than the discovery of a road to attain a particular end, it does not at all interfere with another man discovering another road to attain that end, any more than it would be reasonable to say that if one man has a road to go to Brighton by Croydon, another man shall not have a road to go to the same destination by Dorking. They are roads and means of attaining the end, and unless you can prove that one is a colourable imitation of the other, or unless you can show that one bodily incorporates the other, with merely an addition, it is impossible to say that they shall not be co-existent subjects of con-

temporaneous patents." It requires but little to persuade the Court to draw a distinction between processes for the above purpose. A change of temperature at one point of manufacture may be such an alteration of the process as to afford proper subject matter for a new patent. Again, a new process may consist of the omission of a single step in an old process. In Booth *v.* Rennard (26 L.J. Ex. 23) the patentee claimed as his invention the making of gas direct from seed instead of making it from oil previously extracted. By this means the patentee got rid of one out of two steps. In giving judgment for the patentee, Cockburn, C. J., said :—"Prior to this invention the gas was obtained from oil previously expressed. The patentee says that instead of going through that first process of abstracting the oil he makes it all one process. I think that there can be no doubt it is a useful invention, and one for which a patent can be obtained supposing it to be new."

In determining whether a new process is a new manufacture, and as such capable of being the proper subject matter of letters patent, the element of cost of production is taken into material consideration. In the case of Boulton *v.* Bull (2 H. Bl. 463) Chief Justice Eyre said :—"In the list of patents with which I have been furnished there are several where the sole merit and the sole effect produced are the saving of time and expense, and thereby lowering the price of the articles and introducing it into more general use. . . . The advantages to the public from improvements of this kind are beyond all calculation important to a commercial country, and the ingenuity of artists who turn their thoughts towards such improvements is in itself deserving of encouragement, and in my apprehension it is strictly agreeable to the spirit and meaning of the Statute of James I. that it should be encouraged."

In such cases the commercial success of the patent must be regarded in order to ascertain whether it has proved so useful as to be worthy subject matter for a patent. To use the language of Lord Halsbury in the Badische Anilin und Soda Fabrik *v.* Levinstein (12 A.C., 712), while "the element of commercial pecuniary success has no relation to the question of utility in patent law generally, yet where the question is of improvement by reason of cheaper production, such a consideration is of the very essence of the patent itself, and the thing claimed has not really been invented unless that condition is fulfilled."

So far from showing that they had invented a new process which sensibly cheapened the manufacture of sodium hydrate from a solution of brine, it seems that the method adopted by the plaintiffs in the Castner-Kellner case was scarcely an improvement upon that which had been known and protected by prior inventors. The extraordinary expense to which the parties must have been put in these proceedings illustrates the value which they place upon the right to use the process in question. Until the true secret of the Brunner-Mond process comes to be known, the economical manufacture of caustic soda must ever be a goal towards which the manufacturing chemist will direct his aims and ambitions.

## NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

### NEW PATENTS, 1901.

Compiled expressly for this journal by W. P. THOMPSON & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, Manchester, and Birmingham, to whom all inquiries should be addressed.

10,377. "Main controlling electric switch." S. DIXON & SON, LIMITED. May 20th.

10,413. "Improvements in adjustable resistances." A. H. MAYES. May 20th.

10,452. "Improvements in and relating to safety locks for lift stage doors." F. H. HEADLEY. May 20th.

10,459. "Improvements in storage batteries." V. G. APPLE. May 20th (Complete.)

10,480. "Improvements relating to telephonic systems." A. H. HICKLEY. May 21st.

10,482. "A cell for electrolysis." A. A. GOVAN. May 21st.

10,505. "Improvements in storage batteries." T. A. ADISON. May 21st. (Complete.)

10,506. "Improvements in magnetic separating apparatus." THE EDISON ORE-MILLING SYNDICATE, LIMITED. (T. A. Edison, United States.) May 21st. Complete.)

10,559. "A new or improved telephone receiver holder." G. S. MEYER. (Date applied for under Patents, &c., Act, 1883, Section 103, December 8th, 1900, being date of application in United States.) May 21st.

10,562. "Improvements in dynamos and electric motors." S. HUTCHINS. May 22nd.

10,569. "Improvements in means or apparatus for preventing contact of telephone and telegraph wires with the trolley wires of electric tramway installations." W. W. MCLAUCHLAN. May 22nd.

10,571. "Improvements in junction boxes for electric wire and like installations." G. H. WOODS. May 22nd.

10,587. "Improvements in electrical lampholders." G. SPERRYN and W. H. WOOD. May 22nd.

10,600. "Improvements in or applicable to compensating apparatus for signal wires." J. S. GAUNT and E. TILSTON. May 22nd.

10,609. "Electro-magnetic electric railway track switch and means for controlling and operating same." P. B. WILLIAMS. May 22nd.

10,623. "An improvement in telephone apparatus." A. H. NICHOLSON and THE NEW PHONOPORE TELEPHONE COMPANY, LIMITED. May 22nd. (Complete.)

10,654. "Improvements in resistances for the control of electric currents." T. E. WEAVER. May 23rd.

10,655. "Improvements in or connected with electrolytic bells or apparatus." G. BELL and G. W. BELL. May 23rd.

10,686. "An improved street lantern for gas and incandescent electric lighting." W. EDGAR. May 23rd.

10,687. "Prepayment apparatus for the supply of gaseous electric or other fluids for a given period of time." H. COONEY. May 23rd.

10,700. "Improvements in electric trams and railways." R. HACKING, A. W. HANCOCK, and J. LEIGHTON. May 23rd.

10,733. "Improvements in high potential electric switches." THE BRITISH THOMSON-HOUSTON COMPANY, LIMITED. (W. Le R. Emmet and E. M. Hewlett, United States.) May 23rd. (Complete.)

10,734. "Improvements in train control systems for electric railways." THE BRITISH THOMSON-HOUSTON COMPANY, LIMITED. (F. E. Case, United States.) May 23rd. (Complete.)

10,735. "Improvements in electric circuit breakers." THE BRITISH THOMSON-HOUSTON COMPANY, LIMITED. (S. B. Stewart, Junior, United States.) May 23rd. (Complete.)

10,736. "Improvements in high potential electric switches." THE BRITISH THOMSON-HOUSTON COMPANY, LIMITED. (W. Le R. Emmet, E. M. Hewlett and C. C. Badeau, United States.) May 23rd. (Complete.)

10,737. "Improvements in electric circuit breakers." THE BRITISH THOMSON-HOUSTON COMPANY, LIMITED. (S. B. Stewart, United States.) May 23rd. (Complete.)

10,743. "Improvements in electric engines for surgical and dental purposes." E. W. MAYER. May 25th.

10,747. "Improvements in electric ignition plugs for internal explosion engines and chiefly as used with motor road vehicles." E. GARDNER, T. H. GARDNER, and L. GARDNER. May 25th.

10,756. "Improvements in magnet coils or solenoids." B. M. DRAKE, C. C. GARRARD, G. S. RAM, and THE NERNST ELECTRIC LIGHT, LIMITED. May 25th.

10,757. "Cut-out for incandescent lamps with glowers consisting of conductors of the second class." C. C. GARRARD and THE NERNST ELECTRIC LIGHT, LIMITED. May 25th.

10,758. "Improvements in electric incandescent lamps in which the glower or light giving body is a conductor of the second class." G. S. RAM and THE NERNST ELECTRIC LIGHT, LIMITED. May 25th.

10,766. "Improvements in electro-magnetically controlled looms and kindred textile machinery." A. P. S. MCQUISTEN. May 25th.

10,769. "Improvements in prepayment devices for telephones." R. B. JENTZSCH and G. VON ALVENSLEBEN. May 25th.

10,793. "Improvements in electric indicators." W. J. POLYBLANK. May 25th.

10,795. "Generating electricity for the propelling of machinery or for other similar and useful purposes." W. SUNTER. May 25th.

10,848. "Improvements in apparatus for winding coils for continuous current dynamo and motor electric machines." A. W. TOMKINS. May 25th. (Complete.)

10,867. "Manufacture of thorium, zirconium, and elements of the ytterite group." C. D. ABEL. (Siemens & Halske Aktien Gesellschaft, Germany.) May 25th.

10,868. "Manufacture of metallic thorium, zirconium, and elements of the ytterite group and the production of coatings of the said metals upon other bodies." C. D. ABEL. (Siemens & Halske Aktien Gesellschaft, Germany.) May 25th.

10,869. "Manufacture of incandescence bodies for electric lighting." C. D. ABEL. (Siemens & Halske Aktien Gesellschaft, Germany.) May 25th.

10,871. "Improvements in telegraph and telephone systems." F. G. T. PARSONS and D. H. STURMAN. May 25th.

10,879. "Improvements in voltaic cells." W. K. L. DICKSON. May 25th.

10,887. "Improvements relating to electric arc lamps." H. O. SCHMIDT. May 25th. (Complete.)

10,888. "Improvements relating to electric switches." F. W. BUSCH. May 25th.

### ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 322, High Holborn, W.C., and at Liverpool, Manchester and Birmingham, price, post free, 9d. (in stamps).

#### 1899.

**9,681. "Improvements in electric circuit-breakers." R. Belfield. (L. B. Stillwell.)** Dated May 8th, 1899. Cut-outs for breaking a circuit when the direction of the current is reversed. A motor is arranged to reverse its motion on a reversal of the line current. Such movement is limited by stops, and serves to make or break a circuit for operating a cut-out. 3 claims.

**9,811. "Improvements in or relating to the manufacture of insulating material for electric cables and the like." G. E. Heyl-Dia.** Dated May 9th, 1899. Relates to improvements in the invention described in Specification No. 2,610, A.D. 1899. Any pulp, such as straw, esparto, &c., is mixed with water, oil, benzine, or spirits containing oils or resins, and either a paper is formed or the pulp is used in a squirting machine for covering electric cables. When water is used, the oils, &c., are saponified, and after mixture the soaps are decomposed by an acid solution. The paper is heated, and may be rolled, or not. 4 claims.

**10,241. "Improvements in electrical incandescence lamps with osmium filaments." O. Imray. (Oesterreichische Gasgluhlicht and Electricitats-Gesellshaft.)** Dated May 15th, 1899. Relates to incandescent lamps.—Filaments are made of osmium or osmium with a small proportion of carbon or a hydro-carbon, or with a small or large amount of a metal such as zirconium, thorium, niobium, or tantalum or silicum. An osmium filament may be made as described in Specification No. 1,535, A.D. 1898, and heated in a hydro-carbon gas at low pressure, to introduce a small proportion of carbon, or coated with a paste of zirconia or other oxide and carbon, sugar, or other carbonaceous material, and heated to incandescence in a vacuum or reducing-gas, to reduce or partly reduce the oxide. The reduction may also be effected by gas previously occluded in the osmium filament. Or the mixed materials may be formed into a filament and

heated similarly; other platinum metals may be included in them. The filaments may be subsequently coated with refractory oxides. The filaments are mounted in clean bulbs of glass containing no easily reducible oxides, preferably an infusible potash-soda glass. The bulb is filled with dry hydrogen or illuminating gas. The filament is heated to intense whiteness until it ceases to give off gas during exhaustion, and the bulb is sealed after admitting a very small quantity of hydrogen or illuminating gas. The filament is afterwards improved by moderate incandescence for a long time. 9 claims.

**12,874. "Improvements in glass globes, screens, covers, or the like, for electrical incandescence and other lamps, and in means for manufacturing the same." E. Applegarth.** Dated June 20th, 1899. Relates to lamp shades, chimneys, globes, reflectors, and the like, for electrical, gas, and other lamps, which are cast or moulded with prismatic or other lens-like formations upon both the inner and outer surfaces, in order to diffuse, reflect, or refract the rays of light. To facilitate construction, the globes &c., may be cast in two parts, which are subsequently fitted together and secured by wires. 3 claims.

**16,094. "A watchman's electrical tell-tale system or apparatus." A. Eckstein and H. J. Coates.** Dated August 8th, 1899. Tell-tales for checking watchmen. The stations are connected in series with a dead-beat ammeter or voltmeter, which works an arm carrying a style for tracing on a revolving drum. Circuit is completed by a key switch at each station when the watchman arrives, and owing to the various resistances of the different stations, the styles make a longer or shorter mark on the drum; the distances between the marks show the intervals between the visits. In the form of apparatus shown each station has its own battery, but one battery may be employed, and resistances may be introduced; for long-distance circuits the resistance of the circuit wire alone is sufficient. Switches—The switch is arranged to ensure that the circuit is completed for sufficient time to make the record. A key is placed over the spindle, and engages a notch in a cam. This cam is prevented from being turned in the wrong direction by a spring, and when turned in the right direction, another spring moves into contact with the screw. A complete rotation must be given to the key before it can be removed. 5 claims.

**16,132. "Improvements in the method of and means for inducing magnetism in magnetic circuits, applicable to alternating current motors, transformers, and the like." The British Thomson-Houston Company, Limited. (C. P. Steinmetz.)** Dated August 8th, 1899. Relates to means for inducing magnetism in magnetic circuits for motors or transformers, and for obtaining polyphase currents from simple alternating currents. The construction of an alternating current motor, in which a rotary field is produced from a single-phase current, is shown. The armature or rotor, which may be of any suitable construction, is shown as a mass of laminated iron mounted on a shaft. The field magnets consist of two masses of iron separated by a space, and having pole faces separated by recesses for the reception of field coils arranged in the plane of the axis of the armature. The iron masses are held in a suitable framework. The exciting coils are shown diagrammatically, having a different number of turns, arranged at right-angles, and connected in series with the alternating current circuit. Additional coils are short-circuited through a resistance. Owing to the action and reaction of the inducing current in the coils, and the lagging induced current in the additional coils, a rotating magnetic field having two axes is produced in the iron masses, its lag and intensity depending upon the resistances of the four magnetic circuits, &c. In a modified form, the rotor consists of iron masses at right-angles, carrying the exciting coils. In another form, the armature has short-circuited coils, and the field has poles with faces arranged at varying distances from the armature, so as to vary the resistances of the magnetic circuits. In a small motor, suitable for an electric meter, iron cores may be entirely omitted, or the rotor may carry iron strips. A transformer adapted to produce polyphase currents from a single-phase exciting current is shown. The iron cores have different masses and resistances. The exciting coils connected in series have a different number of turns suitably proportioned. The cores also carry coils short-circuited through a resistance. 27 claims.

**16,167. "Improvements in or relating to switches for conductors in electric traction systems." H. O. Joedicke.** Dated August 8th, 1899. Electric railways and tramways, especially those with overhead conductors. Conductors:—The switch at the meeting of three overhead or other conductors consists of two spring-controlled tongues with guide-plates to prevent the collector from jumping off. 2 claims.

**16,198. "Improvements in and connected with multiple switchboards." H. Oppenheimer. (Actiengesellschaft, Mix & Genest.)** Dated August 9th, 1899. Multiple telephone switchboards are arranged with the complete set of jack strips spread over each two consecutive sections. The annunciators are arranged on the system of two steps forward and one back, this applying to each set of four sections of the board. The switchboard is described as having 12 sections, special testing-jacks being omitted, and the ordinary jacks taking the place of the same. 1 claim.

**16,199. "Improvements in, and connected with, switches for high voltage." H. Oppenheimer.** Dated August 9th, 1899. Switches adapted for high voltages, the handle being turned in one direction only for both make and break. In a recess in a base are mounted two concentric crown-wheels, $b^1$ and $b^2$, with the teeth sloping in opposite directions. Free to slide on the spindle but turning with it, is a toothed wheel engaging with the wheel, $f^2$. A cross-bar having teeth engaging with the wheel, $b^1$, is loosely mounted on the spindle, $d$, and is connected to it by a spring, $n$. This bar slides vertically in a slotted tube, to which is suitably connected the contact-bar or bridge. On turning the handle the toothed wheel rises on the wheel, $b^2$, carrying with it the bar, until its teeth leave the teeth of the wheel, $b^1$, when the spring carries round the bar, and with it the tube and contact. The contact may be divided and the fixed contacts arranged for a two-way switch. 3 claims.

**16,200. "Improvements in holders for electric incandescent lamps." H. Oppenheimer. (Actiengesellschaft Mix and Genest.)** Dated August 9th, 1899. Incandescent lamps, holders for. A cylindrical insulator is made with an S-shaped inner part to receive two angular plates, provided with lateral binding screws to secure the supply wires. The plates are secured by screws inserted from the front surface of the insulator, and having their heads sunk. Plungers, retaining washers, tubes and springs are held in holes in the insulator by the plates so that only the plungers project. A straight groove is forced in the front of the insulator, between the plungers. The rear ends of the plunger tubes may be closed by bending in tongues. Projections in the parts of the casing engage grooves in the insulator to prevent turning. 3 claims.

**16,210. "Improvements in the manufacture of thin tubes or sheets of copper and other metal by electro-deposition." A. G. Cowper-Coles.** Dated August 9th, 1899. Making metal tubes and sheets of copper or other metal by successively depositing coatings or layers of the required metal on a cathode or mandrel while it is rotated at a high speed—for example, in the manner described in Specification No. 21,974, A.D. 1898. Before each coating or layer is deposited a thin layer of greasy matter, or of oxide, sulphide, or the like, is applied to the mandrel. 1 claim.

**16,215. "Improvements in electrolytic baths." W. Walker, jun., F. R. Wilkins, J. Lones, and Jos. Lones.** Dated August 9th, 1899. Cells and receptacles; zincates, obtaining.—Relates to electrolytic baths, principally intended for the production of sodium or potassium zincate. The baths are founded on the galvanic cells described in Specifications No. 23,007, A.D. 1892, No. 10,942, A.D. 1893, and No. 646, A.D. 1894, and the current used is that produced in the cell itself, assisted, if desired, by any outside current. The cell is formed of a slate slab base, perforated slate sides, and plain slate ends. Running longitudinally along the centre of the cell is a slate bar, V-shaped on its upper surface, and provided with cross passages. On each side of the bar is a perforated slate, outside of which is an asbestos or woolen sheet. The inner compartment contains a caustic soda or potash solution, and the outer compartment granular carbon, the finer particles being arranged near the diaphragms, and the coarser towards the sides. Thick amalgamated zinc bars are suspended from a rod, and dip into mercury. Nickel strips or thin perforated plates are suspended in the carbon, to act as collectors of the current. The terminals of the nickel strips and the terminal of the rod are connected together by a copper bar, so as to short-circuit the cell. The required zincate forms in the compartment, while the nascent hydrogen evolved at the carbon combines with the oxygen of the air, thus preventing polarisation. The compartments on each side of the compartment communicate with one another by the passages, and any liquid accumulating in these compartments escapes by the tube. 1 claim.

**16,247. "A new material adapted for electrical insulation, and also for many purposes for which ebonite, wood, and such like materials are used." A. Smith.** Dated August 9th, 1899. Relates to the preparation of a material applicable for use as a wood or ebonite substitute, a plastic composition for the manufacture of boxes, acid, &c., proof chemical apparatus, &c., and as an electric insulating-composition for various electrical purposes, such as cells, partitions, &c. The material is prepared by mixing acetic paraldehyde with methylated spirit and liquid carbolic acid and adding the following to the mixture in small doses:—Fusel oil, methylated spirit, or a mixture of the two saturated with hydrochloric acid gas. The resultant product may be saturated with paraffin wax by immersion. The acetic paraldehyde may be replaced by double the amount of pure acetic aldehyde, or by polymerised formic aldehyde, or by polymerised formic aldehyde dissolved in fusel oil saturated with hydrochloric-acid gas or sulphurous gas. Carbolic acid crystals are employed in this case. Resin, lac or gums may be dissolved in the mixture before adding the gaseous solution. The product may be absorbed by asbestos pulp. 2 claims.

**16,267. "Improvements in electrical apparatus for sorting articles according to one of their dimensions." W. H. Lock and J. J. Milner.** Dated August 10th, 1899. The apparatus is for sorting articles according to their thickness, and is shown for separating the matrix blanks of the linotype machine described in Specification No. 14,682, A.D. 1890, into three sizes, too small, standard, and too large. By increasing the number of "feelers" in the gauge and of shoots in the apparatus, it may be adapted for a greater number of sizes. The blanks to be gauged are piled up in a hopper, and are fed therefrom, one at a time, by a pusher reciprocated by the action of a cam fixed on the spindle of the driving pulley of the machine. The mouth of the hopper is fitted with an adjustable spring plate, to prevent more than one blank from being delivered at a time; this plate yields slightly to an abnormally thick blank, to prevent jamming. The blank so fed forward is left under a vertically-reciprocated gauge, which is raised and lowered also by cam action. The gauge has two "feelers," 45, 46, consisting of spring pushers, delicately adjustable, and connected with a battery and electro-magnets 103, 106, which control the switches or gates 69, 68 of the sorting shoots. If the blank be too small the lower pusher does not touch it, and the next oncoming blank pushes it forward and discharges it down a central shoot between the switches of gates 68 and 69, which are held parallel to each other by springs and armatures. If the blank be of normal size, the pusher 45 touches it, circuit is completed for the electro-magnet 103, and the gate 69 is swung to the left, closing the central shoot, and guiding the blank down one on the right; the gate is locked in this position by a spring catch. Should the blank be too large, the pusher 45 is thrust upwards, touches the pusher 46, and both electro-magnets 103, 106 are energised. The gate 68 is thus swung to the right and locked, and the blank passes down a shoot to the left. In the continued action of the machine a reciprocating bar frees the latches, so that the gates are returned to normal position, and a pusher mechanism turns the sorted blanks on end and pushes them into receptacles with sliding bottoms. The downward movement of the gauge is exactly determined by a finely-adjustable screw stop. 8 claims.

**16,285. "Improvements in plugs for telephone switchboards." E. D. Pearmain.** Dated August 10th, 1899. The body of the plug is split at the rear end, and is tapered on the outside so as to allow of drawing together to clamp the covering of the flexible cord. The metal ring is held from rotating by a pin on the plug body. A pin on the ring also engages in a slot in the fibre cover. Nuts are provided for holding the cover and ring in position. 1 claim.

**16,290. "A new improved apparatus for closing and opening electric circuits, applicable to the temporary illumination of rocks on coasts and of staircases and other analogous purposes." J. Levy.** Dated August 10th, 1899. Relates to the temporary electric lighting of rocks, canals, staircases, &c. In the case of a waterway, the lighting apparatus is in a relay circuit controlled by Hertzian radiations from an approaching ship. A thermal arrangement is fitted in the circuit for opening the lighting circuit after a certain interval. One arrangement consists of lighting mains and a coherer in a local circuit also including an electro-magnet, the armature of which carries a contact for completing the lamp circuit. In this circuit is a coil adapted to be heated and enclosed in a vessel containing a gas or the like. After the lamps have been alight a certain time the heated gas drives out the mercury from the vessel making contact and energising a magnet. This tilts the armature and breaks contact. For lighting staircases the coherer is replaced by a simple push for closing the circuit of the magnet. In a modified arrangement the closing of the circuit, including the magnet for extinguishing the lamps, is controlled by a metallic rod, the expansion of which closes certain contacts. 2 claims.

**16,293. "Improvements in the manufacture of leaden plates for secondary batteries or accumulators, and in moulds and tools to be employed in such manufacture." P. J. Davies.** Dated August 10th, 1899. Relates to the manufacture of leaden plates for secondary batteries, especially those known as "Leitner" plates. A mould for casting the plates, consists of two pieces of brass, formed with recesses for the thin central portion of the plate and the stout strengthening edges respectively. To enable the thin plate to be cast successfully, the mould is heated by flames from bunsen burners and perforated pipes may also be fitted through which cold air may be directed up on the moulds for cooling purposes. The molten lead enters the mould through channels, the finished casting being thus surrounded by runners. The runners are subsequently removed by shearing devices or by means of circular saws, and the upstanding edges are turned down so as to form channels round the plate which assist in holding the paste or active material. The perforations may be produced either by punching or by the use of cores in the mould. For the flanges may be substituted burred edges produced by passing the plate between suitable rollers. When very thin plates are required, sheet lead may be placed in the mould and the necessary borders, lugs, &c., may be cast on it, or the plate may be cast in the manner described above, and may be subsequently rolled out by rollers having suitable recesses or grooves corresponding with the borders or lugs. The mould is preferably mounted on a casting-table such as that described in Specification No. 21,031, A.D. 1890. The perforations are D-shaped holes punched with spurs which assist in retaining the active material. An apparatus for removing the runners from the cast plates consists of a pair of rotary saws, revolving on opposite sides of a table on which slides a carriage to which the casting is clamped. The runners project over the edges of the saws, and are removed as the carriage advances along the table. 6 claims.

**16,300. "Improvements in safety fuses for electric circuits." E. T. Goslin.** Dated August 10th, 1899. In order to minimise arcing in safety fuses, the fusible wire supports a portion of the conductor which, when the fuse melts, falls away and breaks the circuit at another point. The fuse is used in connection with a double-break switch as follows: The fusible wires support the conductor, which is fitted in an insulating tube and slides within the movable part of the switch, which is hinged. The other end of the conductor is fitted with a socket and spring contact, with which a plug coupling engages, the spring securing good contact. The fusible wires connect the conductor with a ring carrying the contacts of the switch, and the plug is connected to the other contact. When the fuse blows, the conductor falls into a suitable tubular receptacle. 4 claims.

**16,352. "An improved system of telegraphy." F. Bedell.** Dated August 11th, 1899. Relates to a system of telegraphy in which sinusoidal or other similar currents of single sign are employed, the makes and breaks being obtained at the moment of zero potential. When signalling with a perforated slip, two lines of perforations are employed, the lower line being connected to the source of current to produce a dash. Describes also the method of obtaining the phase current by means of a battery and a variable resistance, the rotating or sliding arm of which cuts the resistance in or out of circuit. Several arrangements of the resistance are described, in which the phase current may be repeated by cross or other connections of the resistances with a rotating contact arm, or a contact arm passing over a carbon ring of varying resistance is employed. The currents may also be produced by dynamos, either of the unipolar type or of the type in which the armature winding and commutator connections are arranged to give both alternating and continuous currents, which so react as to produce either a single varying current of one sign or two separate currents each varying and of opposite signs. One arrangement is described in which the single winding of a Gramme ring is connected to a collector and to a commutator, the two circuits being led to a transformer. The armature may be double-wound, to give separate circuits, and in some forms rotary brushes are employed. 7 claims.